# Action for a cleaner tomorrow

## A South Carolina Environmental Curriculum Supplement

DHEC
PROMOTE PROTECT PROSPER

Published by the
**South Carolina Department of Health and Environmental Control's**
**Office of Solid Waste Reduction and Recycling**
2600 Bull Street, Columbia, South Carolina 29201

For additional teaching materials including fact sheets, guides, posters, videos and more, contact DHEC's Office of Solid Waste Reduction and Recycling at **1-800-768-7348** or **visit www.scdhec.gov/recycle**.

Printed on **RECYCLED** Paper DHEC OR-0685 7/12

# Table of Contents


**AIR QUALITY**

Air, Air Is Everywhere.....3
Don't Take a Lichen for Pollution.....5
Give Burn Barrels the Boot .....13
The Greenhouse Effect .....17
Stick 'Em Up.....19
Temperature Inversion.....21
This Is the Way We Use Our Air .....25
Today's Forecast... .....29

**ENERGY**

Recycling: It's an Energy Issue .....33

**RECYCLING**

Can you dig it?.....39
Crayon Trash Stash .....45
Environmental Shopping.....47
Garbage Snooping .....53
Hazardous Household Waste.....59
Look in Your Garbage Can.....67
Musical Resources .....71
My Bag.....79
Natural or Man-made?.....83
Population and Garbage .....85
Recycle – Don't Litter.....89
Recycle It!.....93
Recycling 101 .....99
Recycling: A Valuable Lesson.....101
A Rotten Idea .....107
When They're Gone,
They're Gone.....111
Where does garbage go? .....115

**WATER**

Life in a Fish Bowl .....121
Oil and Water.....125
The River Flows Along .....129
Runoff Race.....133
Taking the Swamp Out
of Swamp Water .....137
We All Live Downstream.....139

**RESOURCES**

Lesson Correlations .....141
Backyard Composting .....143
Buy Recycled ... and Beyond.....145
Garbage 101 .....147
Hazardous Household Products.....149
Landfill 101 .....151
Natural Resources.....153
Recycling 101 .....155
Residential Recycling:
Back to the Basics.....157
Used Motor Oil Recycling .....159
Glossary .....161


## About 'Action'...

"Action for a cleaner tomorrow: A South Carolina Environmental Curriculum Supplement" ("Action") is an activity-based interdisciplinary curriculum supplement that can serve as a starting place for introducing basic environmental education in the classroom.

The curriculum supplement is the centerpiece environmental education and outreach program of the S.C. Department of Health and Environmental Control (DHEC). "Action" was created in 1992-1993 by DHEC in conjunction with a statewide curriculum development team of teachers and the S.C. Department of Education.

By any account, "Action" has been a success. This is the 13th revised edition of the curriculum supplement. About 52,000 teachers and other educators have been trained on "Action" since its introduction in 1993. "Action" lessons have been taught in classrooms to thousands of students throughout the state.

This edition reflects the commitment by DHEC to constantly update and revise lessons not only to provide the latest information available, but also to make the changes in the curriculum supplement that the state's teachers ask for and need. That commitment includes additional support beyond the curriculum supplement including printed material, DVDs, presentations and other programs.

There are 32 lessons in this edition. Correlated to the latest South Carolina science standards, the subjects covered include recycling, landfills and hazardous household waste, conserving natural resources, protecting air and water as well as one new lesson on school recycling. When possible, South Carolina-specific information is provided that will help bring the environmental issues home.

Each lesson provides the learning objective and background as well as teacher preparation time. A learning essentials block gives additional information for teachers including teaching time, material needed and vocabulary. Following the lessons, correlations to the state's science standards are listed as well as additional in-depth lesson resources and a glossary.

Each lesson is designed to include hands-on activities that help students get the facts, think for themselves, form opinions, make decisions and take "Action" for a cleaner tomorrow.

## You Should Know...

- "Action" and "Action" workshops are provided at no cost to schools and teachers. Call **1-800-768-7348** for information.
- "Action" has won several national awards including the Excellence in Solid Waste Education Award from the Solid Waste Association of North America, the National Recycling Coalition's Beth Brown Boettner Award for Outstanding Public Education, Best Energy Education Promotion Award for Educational Computerized Tool from the U.S. Department of Energy and the White House "Closing the Circle" Award.

## Acknowledgments


Developing "Action" has involved education, environmental and communication experts from across South Carolina. The success of "Action" is a result of the dedication and talent of many people.

DHEC's Office of Solid Waste Reduction and Recycling thanks the many S.C. educators who served on its curriculum development team and as pilot testing teachers. Their expertise was essential in preparing "Action," South Carolina's environmental curriculum supplement.


**Action for a cleaner tomorrow**

**A South Carolina Environmental Curriculum Supplement**

# AIR, AIR IS EVERYWHERE

**PREPARATION TIME:** **EASY-TO-DO**

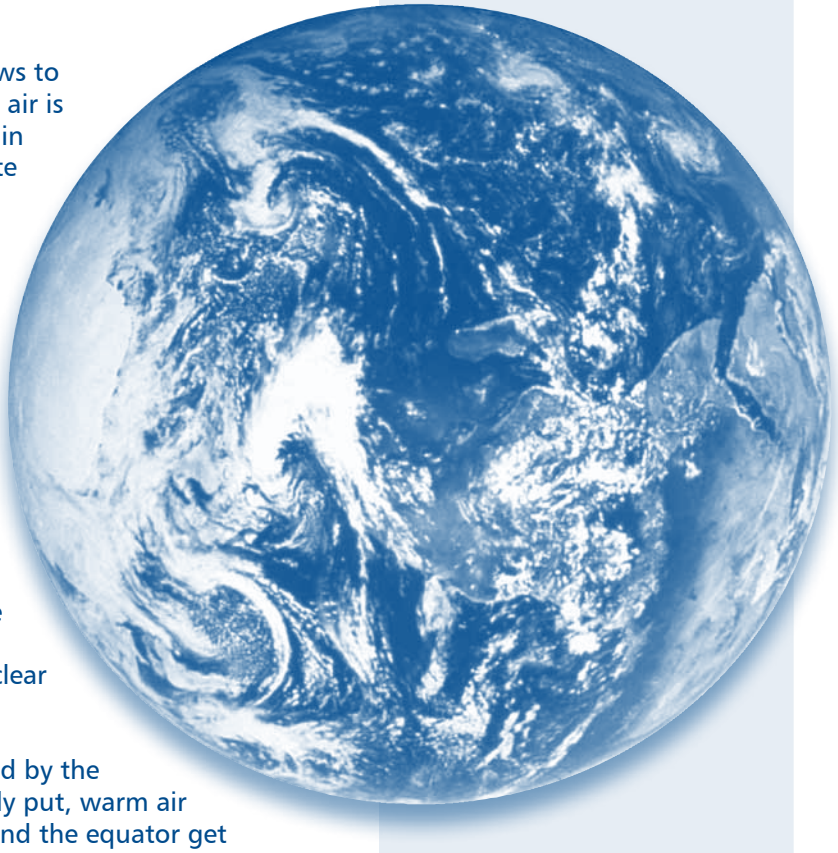
## Learning Objective

Students will name and describe the characteristics of air.

## Background

Our planet, Earth, is surrounded by a mixture of gases that we refer to as **air**. This blanket (or layer) of air is composed primarily of **nitrogen** (78 percent) and **oxygen** (21 percent) and is critical to sustaining life on Earth. We use the term **ambient air** to refer to the air that surrounds us. In our atmosphere, ambient air is in the layer called the troposphere. This layer of air keeps some of the sun's heat near the Earth's surface (which provides the Earth with helpful warmth) and provides oxygen for animals and carbon dioxide for plants.

Air is a fluid (not a liquid, but a fluid) that flows to fill corners, holes, nooks and crannies. In fact, air is everywhere in the Earth's troposphere except in places where it has been pumped out to create a vacuum. Because we cannot see air unless it contains solid particles or liquid particles (as in **fog**, **smog** and **smoke**), it is easy to forget that it occupies space all around us. Another interesting characteristic of air is that because it is a fluid, air takes the shape of the container that is holding it. The container might be a room, a bottle, a tire, a cave, a balloon, etc.



One way that we are frequently reminded of air's presence is by its movement. We feel it as a stiff March **wind**, a gentle summer breeze, or a hurricane-force gale. Whether we actually feel it or simply see its effects (e.g., leaves rustling on trees, clouds moving), it is clear that air is often in motion.

The air movement in our troposphere is caused by the uneven heating of the Earth by the sun. Simply put, warm air rises and cool air falls. Generally, regions around the equator get more direct sunlight and, therefore, become warmer than the regions near the poles. As the warm equatorial air rises and the cold polar air sinks, circulations develop in which air masses move over the surface of

*Continued on the following page*

## Learning Essentials

**Focus:** Properties of air

**Subject:** Science

**Extensions:** Health, Language Arts, Math, Reading, Social Studies

**Materials:** See list provided

**Teaching Time:** Two class periods

**Vocabulary:** Air, ambient air, fog, nitrogen, oxygen, smog, smoke, wind

the Earth. This exchange creates wind. Other factors influencing the force and direction of air movement are land forms and the rotation of the Earth.

## Materials

- Clear, empty 2-liter plastic soda bottle
- "The Air Song" Teacher Information Sheet
- Flip chart, chalkboard or SMART Board
- Roll of calculator paper
- Portable electric fan
- Balloons (one per student or group)
- Yarn or string
- Different size balloons (one per student or group)
- Ruler (one per student)
- Magazines
- Liquid dish-washing detergent (to make bubbles)
- Plastic coffee can lids
- Packaging peanuts (one per student)
- Drinking straws

## Learning Procedure

1. Show the students a clear, empty 2-liter plastic soft drink bottle. Ask if there is anything in the bottle. Most children will answer "no." Walk around to each child and squeeze the bottle quickly so each child can feel a puff of air on his hands or face. Respond to the children's reactions by reminding them that they said the bottle had nothing in it. Ask the following questions:

   - Did we see anything in the bottle? (No.)
   - Was there something in the bottle? (Yes.)
   - How do you know? (I felt it.)
   - What was in the bottle? (Air, wind, breath.)
   - How did it get into the bottle? (Through the bottle opening.)
   - Where did it come from? (Outside the bottle.)
   - Can you see the air outside the bottle? (No.)
   - What made the air come out of the bottle? (You squeezed it out.)

   Stress that air is everywhere and usually cannot be seen. Sometimes we can see dirt (particulate matter) and colored gases in the air. Examples include smoke and smog. Even though we can't always see air, we can feel it.

2. Ask the students, "What do you think of when I say "air?" List their responses on a flip chart, chalkboard or SMART Board.

   Examples include:

   - Wind
   - Tornadoes
   - Clouds
   - Airplanes
   - Kites
   - We need it to breathe.
   - You can't see it.
   - It moves things.
   - Clean? Or dirty?

   Younger students may draw a picture. Older students can develop a class mural about air. Direct their discussions to the way people use air or harm the air and encourage them to include these ideas in their illustrations.

3. Give each student an 18-inch (46 cm) length of calculator paper. Allow each child to create his own patterned streamer. Take a few streamers outside to hang in the wind and observe their movement. Hang a few from your classroom ceiling and allow students to blow on them or fan them with a paper fan. Tape two or three streamers to an electric fan grill and watch them float. **NOTE:** Remind students not to try this at home unless they have a parent to help attach the streamer to the fan. Your discussion should guide the children to understand that air moves. Wind chimes, toy parachutes, paper airplanes, gliders, kites or mobiles may be substituted for streamers to enhance the concept of air movement.

4. Have the students inflate balloons and discuss how air takes on the shape of the container in which it is held. Measure the blown-up balloons with string or yarn. Hold the piece of string to a ruler to see how many inches or centimeters the string is. Make a class graph to compare the size of air in each different size or shape balloon. Have them deflate the balloons slowly and ask why it's shape changed. (You let the air out.)

5. Have the students look for signs of air on their way home from school: leaves blowing in the wind; smoke rising in the air; fog; a kite; planes; etc.

# DON'T TAKE A LICHEN FOR POLLUTION*

| PREPARATION TIME: | MODERATE |
|---|---|

## Learning Objectives

Students will:

- recognize three different kinds of lichens;
- measure lichen coverage using grids; and
- predict air quality based on types and amounts of lichens present.

## Background

**Lichens** (pronounced likens) look like plants but are really two types of plants – **fungi** and **algae** – growing so closely together that they look like single organisms. Scientists still do not understand the relationship between the fungi and algae that make up lichens. They often are considered symbiotic organisms – mutually beneficial to each other. The photosynthesizing algae provide food for both while the fungi appear to provide moisture, minerals and support. Lichen fungi, however, cannot live without their algae partners while most of the algae can live by themselves. This may mean that the fungi are parasites using the algae to obtain food and giving little to the algae in return.

Whatever the relationship between the algae and fungi, it is a highly successful one. Lichens often grow in locations where most other plants cannot like bare rocks, tree trunks and bare soil. In some of these locations they play an important role helping soil formation. By interacting with the bare rocks to help break them down chemically and by trapping dust and organic matter from the air, lichens often start to create and enrich soil where other plants can eventually grow. Every natural habitat – from deserts to rain forests – has lichens. They are able to survive extreme conditions of heat, cold and drought. Few species of lichens, however, can survive air pollution – particularly acidic air pollution.

Lichens come in a variety of sizes, shapes, colors and textures. Lichens often are divided into three classifications – crusty, leaf-like or shrubby. Crusty lichens usually grow flat on rocks and tree trunks and may be

*Continued on the following page*

## Learning Essentials

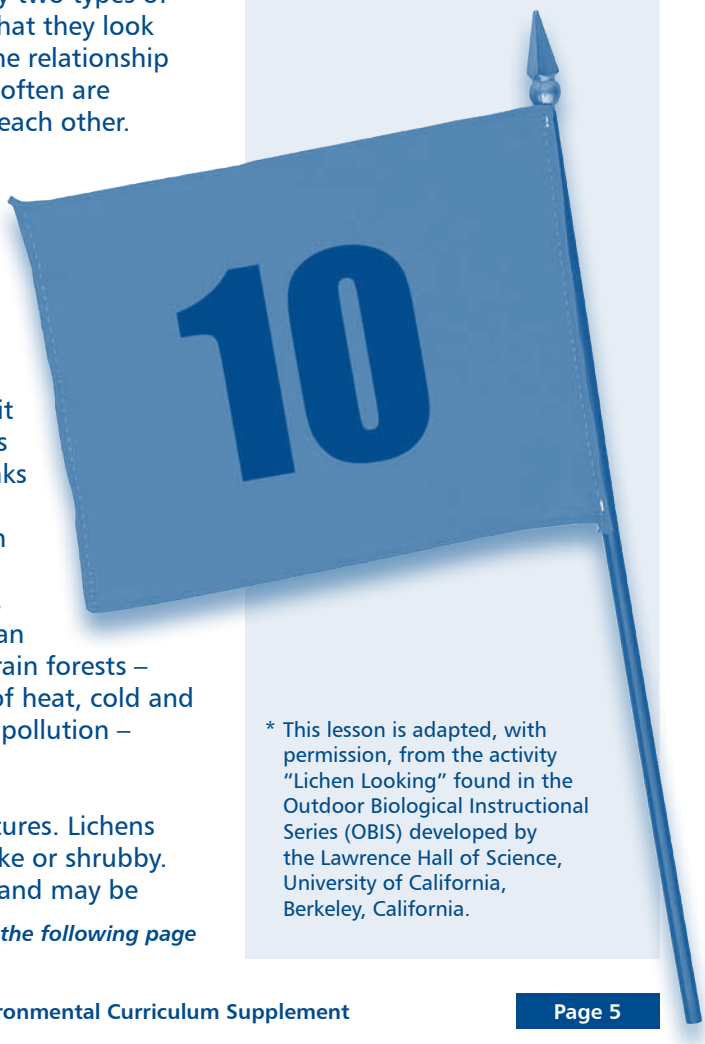
**Focus:** Measuring air quality

**Subject:** Science

**Materials:** Small marking flags (10 of one color for each student group, numbered 1 through 10), envelopes to store flags, masking tape, student handouts and worksheet (included)

**Teaching Time:** One class period with possible extensions

**Vocabulary:** Algae, fungi, lichens




* This lesson is adapted, with permission, from the activity "Lichen Looking" found in the Outdoor Biological Instructional Series (OBIS) developed by the Lawrence Hall of Science, University of California, Berkeley, California.

embedded in these surfaces. Crusty rock lichens are colorful and vary from oranges and yellows to greens, browns, grays and blacks. Leaf-like lichens have lobed surfaces that are only partially attached to other surfaces. Shrubby lichens are branched and either stand upright or hang from other surfaces. Leaf-like and shrubby lichens usually are some shade of green. Lichens often are confused with moss but real mosses are tiny plants with leaves and stems. Because lichens were once mistakenly classified with mosses, some common lichens were named reindeer moss, oak moss and Iceland moss.

Lichens are extremely sensitive to air pollution and sometimes can be used as indicators of air quality. Scientists study both the type of lichens present and the size of the lichens. Shrubby and leaf-like lichens can only survive in clean air. Lichens are relatively rare in large cities, and in areas of very heavy air pollution, there are no lichens of any type. The size of the lichens present also is important. Larger individual lichens generally mean better air quality. In 1971, an air quality map of the British Isles was made based on an evaluation of lichen presence and growth.

Lichens also are valuable for evaluating air quality in another way. Lichens accumulate metals and other elements from rainwater and dust. By analyzing lichens that live near emission sources for chemicals that indicate pollution, scientists can determine how far the pollution has spread.

## Learning Procedure

1. Share the background information with the students and explain that they are going to be looking at lichens. Distribute copies of the "Lichens As Air Pollution Indicators" Student Handout, the "Lichen Grid" Student Handout and the "Measuring Air Quality Using Lichen Size" Student Worksheet. Point out the three classes of lichens.

2. Explain why lichens are used as air quality indicators. Refer to the "Lichens As Air Pollution Indicators" Student Handout noting the part on "Kinds of Lichens." Explain how the types and amounts of lichens present are used to measure air quality.

3. Demonstrate how to trace a lichen onto the "Lichen Grid" and how to count the number of square centimeters the lichen covers. **NOTE:** Count partially covered squares as 0.1-0.9. Demonstrate to the students how to hold the grid over a lichen (without touching it) and draw the outline on the grid.

4. Transport the class to a field location where lichens are present and describe the boundaries of the activity site. Make sure to take the student handouts and worksheet. **CAUTION:** Remind students to watch out for poison ivy. Describe it to them if necessary.

   A. Challenge the students to locate all the places where lichens live at the site. Divide the students into pairs or teams. **CAUTION:** Warn students not to touch the lichens or disturb them in any way. Any damage to them would be long-lasting.

   B. Give each team an envelope with 10 flags and some masking tape. Have the teams mark where they found lichens with the flags by poking the flags into the ground near the lichens or by taping flags next to rock lichens. Give students 10 minutes to complete this task.

   C. Have the students map the area on a piece of graph paper and mark locations of the flags. Again, give students 10 minutes to complete this task. **NOTE:** To reduce confusion and/or to get more consistent results, you may draw a map of the study area ahead of time and make a copy for the students. It should be as simple as possible, outlining the area and indicating major features such as tree trunks (represented by circles), rocks, logs and other possible sites for lichens.

   D. Have students write on the map under each of their own lichen locations the number and the type of lichen(s) found.

   E. Give each team two or three copies of the "Lichen Grid" and have them trace several different lichens. Make sure the students record the location number for each lichen. Allow five minutes for each tracing. **NOTE:** All lichens the students identify (10 per student group) should be measured. After the students have measured one or two, the rest will go faster. The students should measure at least three each.

F. Be sure to remove flags before you leave the site.

5. After finding, mapping and measuring the lichens, the students should complete the following tasks. These can be done at the study site or in the classroom.

   A. Have students measure the size of the lichens in square centimeters. Have the students place the sizes of the lichens beside the appropriate sites on their maps.

   B. Each groups should enter information about their lichens (location, kind and size) on a master map so that the whole class can see the pattern of lichen growth on the study site. NOTE: You may want to duplicate this master map for all the students before the class discusses it.

6. Discuss the results with the students using the "Measuring Air Quality Using Lichen Size" Student Worksheet.

NOTE: Reprinted with permission from "A&WMA's Environmental Education Resource Guide (EERG) – Air Quality, 6-8," 1991; Air & Waste Management Association, Pittsburgh, PA 15222.

## Extension Activity

1. Remove one of the lichens from the study site. Take it to a biology department at a local college or university and have them chemically analyze it for metals. Is there any evidence of pollution? If so, ask students what is causing the pollution and what could be done to prevent it.

2. Select several sites at various distances from a known air pollutant source and conduct this activity at each site.

3. Compare the results. Can you see a measurable decrease in lichen populations as you move toward the air pollution source?

**Student Handout**

# LICHENS AS AIR POLLUTION INDICATORS

Plants called lichens are sensitive to air pollution, especially the air's acidity. So, you can use their presence or absence to see how clean the air is. Shrubby and leaf-like lichens only survive in clean air. In the most polluted areas there are none at all. Look for lichens on walls, stones and trees, and use this scale to rate the air quality.

**NOTE:** Different lichen types can be found in the same area. To use this scale, decide which lichen type is most common in the study area.

## KINDS OF LICHENS

CRUSTY

LEAF-LIKE

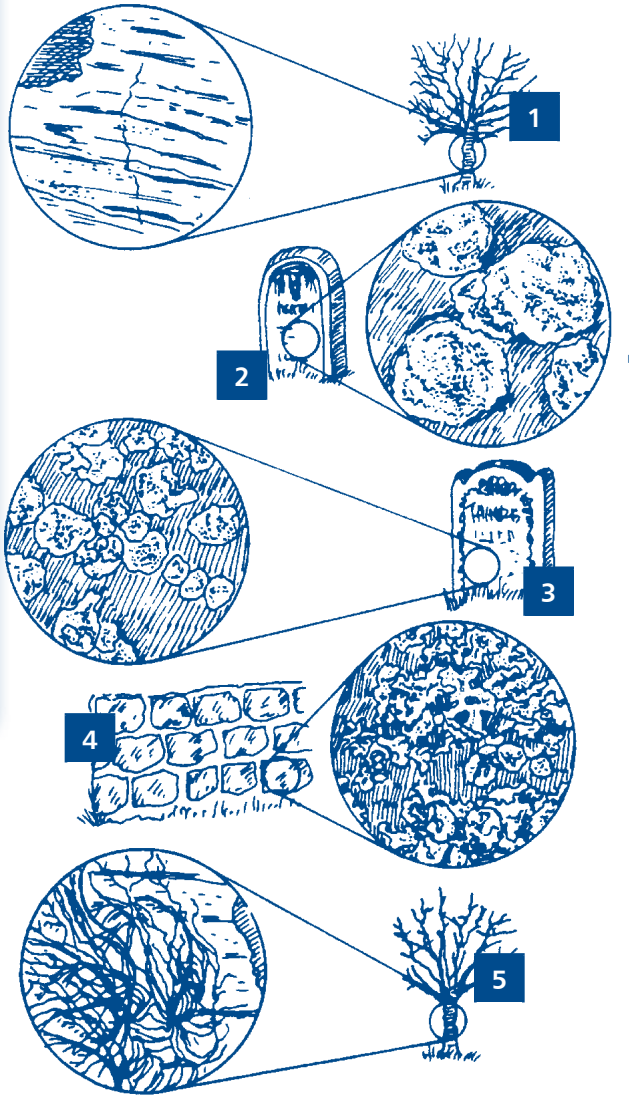
SCRUBBY

## LICHEN SCALE

**POLLUTED AIR**

| | |
|---|---|
| 1 | No lichens (possibly green algae) |
| 2 | Grey-green crusty lichens (tombstones) |
| 3 | Orange crusty lichens (tombstones) |
| 4 | Leaf-like lichens (walls and trees) |
| 5 | Shrubby lichens (trees) |

**CLEAN AIR**



Student Handout

# LICHEN GRID

**Student Worksheet**

Name: _____

# MEASURING AIR QUALITY USING LICHEN SIZE

1. What kinds of lichen did you find? (Circle your answers.)

   a) shrubby
   b) leaf-like
   c) gray-green crusty
   d) orange crusty

2. How many did you find: (Circle your answers.)

   a) none
   b) not many
   c) a few
   d) a lot

3. What was the average size of the lichen?

   Type: _____ Size: _____

   Type: _____ Size: _____

   Type: _____ Size: _____

4. Based on your findings: do you think the air quality in this area is: (circle one answer)

   a) excellent
   b) good
   c) fair
   d) poor

5. What are some potential or possible air pollution sources?

   _____

   _____

   _____

6. What effects air pollution in South Carolina? (Example: land formations, weather conditions, energy usage, etc.)

   _____

   _____

   _____

7. What are some solutions for better air quality?

   _____

   _____

   _____

8. What can you do to help reduce air pollution?

   _____

   _____

   _____

| SIZE (square centimeters) | AIR QUALITY |
|---|---|
| **10 to 12** | Excellent |
| **7 to 9** | Good |
| **4 to 6** | Fair |
| **0 to 3** | Poor |

6. The next day, have them draw and color a picture of what they saw. Then have each child fold his/her picture into a fan. To do this take the bottom end (the width of the paper) and fold it up 1/2 - 1 inch (about 2 cm). Flip the paper over and fold down over the first fold. Keep folding in this accordion-style format to the end of the paper. The paper should now be a series of folds 1/2 - 1 inch (about 2 cm) wide. Have the students grasp one end and spread out the folds or pleats. They now have their own colorful fan.

## Extension Activities

1. Teach the students "The Air Song" on the Teacher Information Sheet to the tune of "The Wheels on the Bus."

2. Blow bubbles outside and watch them float in the air. The plastic rims of 2 pounds (900g) coffee can lids with the centers cut out make excellent hoops for large bubbles. An inexpensive bubble recipe can be made by mixing 2 cups (about .5 liter) of liquid dish-washing detergent to 1 gallon (3.785 liters) of water.

3. Have a "squiggle" race by giving each student a Styrofoam packaging peanut and a straw to blow it. Have the students estimate how many blows it will take to get the packaging peanut across the desk or designated line. Have them experiment with other objects, such as lima beans, cotton balls and small pebbles. They can compare how many blows it took the lima bean to cross the line with how many blows it took the packaging peanut.

4. Take the students outside to fly kites and see how the air makes their kites move.

NOTE: Reprinted with permission from "Environmental Education Resource Guide (EERG) - Air Quality, K-2," 1995; Air & Waste Management Association, Pittsburgh, PA 15222.

## Resources

Althouse, Rosemary and Cecil Main. "Science Experiences for Young Children." New York and London: Teachers College Press.

Baxter, Catherine, Ed. "Body Talk: Breathing." New York: Dillon Press, 1993.

Bendick, Jeanne. "The Wind." New York: Rand McNally and Company, 1964.

Branley, Franklyn M. "Rain and Hail." New York: Thomas Y. Crowell Co., 1963.

Churchill, E. Richard. "Amazing Science Experiments." New York: Sterling Publishing Co. Inc.

Freeman, Mae. "When Air Moves." New York: McGraw-Hill Book Company, 1968.

Gallant, Kathryn. "Jonathan Plays with the Wind." New York: Coward-McGann, 1958.

Henry, Lucia Kemp. "Science Through the Seasons." Belmont, California: David Lake Publisher, Fearon Teacher Aids.

Hutchins, Pat. "The Wind Blew." New York: Macmillan Publishing Co., Inc., 1974.

Kalman, Bobbie and Janine Schaub. "The Air I Breathe – Primary Ecology Series." New York: Crabtree Publishing Co., 1993.

Laas, Ingrid and A. Stenstrup. "K-2 Air Education Unit." Wisconsin Department of Natural Resources.

Pine, Tillie and J. Levine. "Air All Around." Whittlesby House: McGraw-Hill Book Company, 1968.

Rybolt, Thomas and R. Mebane. "Environmental Experiments About Air." Hillside, New Jersey: Enslow Publishers, Inc.

Tresselt, Alvin. "Hide and Seek Fog." New York: Lothrop, Lee, and Shepard Co., Inc., 1965.

The Volume Library, "Health and Medicine Yearbook." Nashville, Tennessee: The South Western Publishing Co.

Whittingham, Richard and B. Brook. "The Earth and the Stars." Nashville, Tennessee: The Southwestern Company.

"The World Book Encyclopedia."

# THE AIR SONG

*Tune: "The Wheels on the Bus"*

The air near the Earth
gets so, so warm
so, so, warm so, so warm.
The air near the Earth
gets so, so, warm,
Each and every day.

*(Students stand, then crouch and fan faces as if hot.)*

The nice warm air floats up, up, up
up, up, up
up, up, up.
The nice warm air floats
up, up, up,
Just like smoke from a fire.

*(Students slowly stand, raising arms.)*

The cool, cool, air comes
down, down, down,
down, down, down,
down, down, down.
The cool, cool, air comes
down, down, down,
And stays down near the ground.

*(Students hug their own bodies as if freezing, then slowly crouch to make balls.)*

The hot and cold air
go up and down,
round and round,
hot and cold.
The hot and cold air
makes the wind
For you and me to play.

*(Students move bodies up and down and swing arms around.)*

# GIVE BURN BARRELS THE BOOT

| PREPARATION TIME: | MODERATE |
|---|---|

## Learning Objectives

Students will:

- learn what happens when different household items are burned; and
- what kinds of air and other pollution can result from open burning.

## Background

**Open burning** is the burning of any material in an open fire or in a container not specifically designed to control air pollution. Open burning includes piling up garbage and burning it or burning garbage in a barrel. Burning garbage can have negative effects on human health and the environment.

What happens when we burn our garbage? Are there better ways to handle it? How could open burning affect someone with asthma or another lung disease? Explain to students that burning garbage is convenient, but it can produce a lot of pollution. Sometimes the smoke can make your neighbors sick – especially if they suffer from asthma or other lung diseases. Open burning puts more pollution into the air. These are reasons why there are strict regulations on open burning in South Carolina – and most of the time, it's against the law.

Thousands of households, mostly in rural areas and small towns, still burn their garbage and yard trimmings instead of recycling, reusing, composting and taking garbage to the local disposal center. But the composition of garbage today (especially items containing **plastic** and various other chemicals) can turn the burning of household garbage into a health concern.

Household garbage tends to burn at a relatively low temperature and with poor combustion. As a result, it generates all sorts of pollutants. Burning garbage creates air pollution containing **toxic** chemicals and particles that can take a toll on even healthy lungs. If something is said to be toxic, it is considered harmful, destructive,

*Continued on the following page*

## Learning Essentials

**Focus:** Pollution created from open burning of household garbage

**Subject:** Science

**Extension:** Chemistry

**Materials:** See the list provided, "Pollution Chart" Student Handout

**Teaching Time:** One class period

**Vocabulary:** Burn barrel, cadmium, dioxins, lead, open burning, plastic, tires, toxic

deadly or poisonous. Burning garbage also can generate chemicals known as **dioxins**. Dioxins are highly toxic to people and wildlife. The ashes and unburned wastes that are left often contain high levels of metals like **lead** and **cadmium** that are especially dangerous to young children. This is why alternatives to burning household waste should be considered.

Temperatures in a **burn barrel** can reach 500$^0$ F. If this sounds very hot, think twice. Regulated municipal incinerators must operate at temperatures reaching 2,200$^0$ F. The high temperatures ensure complete combustion, reducing the amount of toxins produced or destroying them.

A good alternative to open burning is recycling. Recycling saves natural resources, landfill space, money and keeps the air clean, too. Today in South Carolina, many local governments provide roll carts and recycling bins for the curbside collection of household garbage and recyclables. In rural areas, drop-off sites – also known as convenience centers – are provided by local governments for the collection of garbage and recyclables.

## Open Burning

Open burning is a nuisance. Unlike regulated incinerators, burn barrels operate at ground level and the smoke lingers in the area where it is burned. Each year, the S.C. Department of Natural Resources, the S.C. Department of Health and Environmental Control and local governments receive thousands of complaints from residents because of smoke, odors and health concerns caused by open burning. Residents also express concern about barrel fires spreading to their property.

Open burning of garbage, whether in a burn barrel or not, is prohibited by law. Yard trimmings, small quantities of clean, untreated and unpainted wood may be burned unless limited or prohibited by local ordinance. Camp fires and outdoor fires for cooking are permitted and do not require prior approvals unless environmental conditions pose a health threat or wildfire risk.

## Open Burning and Wildfire Risks

Open burning is one of the leading causes of wildfires. Each year, more than 4,000 Americans die and more than 25,000 are injured in wildfires, many of which could have been prevented. Direct property loss due to fires is estimated at $8.6 billion dollars annually. Open burning is costly and dangerous to everyone. If someone's debris fire causes a wildfire, they could be heavily fined and responsible for paying for fire damages.

## What are alternatives to open burning?

There are many. Here is a list of safe alternatives:

- **REDUCE WASTE:** Buy in bulk or look for products with less packaging.
- **REUSE ITEMS:** Reuse them yourself or find someone else who can use them. Have a yard sale or donate items that are in good condition to an organization that can sell or reuse them.
- **RECYCLE:** Newspaper, office paper, cardboard, glass, used motor oil, magazines, aluminum, metal and plastic bottles can be easily recycled in many communities.
- **COMPOST:** Start a compost bin for leaves, grass, vegetable food scraps and plant clippings. In a few months, it will provide a nice soil amendment for your garden or flower bed.
- **PROPERLY DISPOSE:** Take waste materials that can't be recycled, reused or composted to your county landfill or convenience center for disposal.

## Materials

- A container to represent the burn barrel (a 5-gallon bucket works well)
- A clean disposable diaper
- Newspaper and white paper
- A piece of tire
- An aerosol can or bottle half full of cleaning solution
- Greasy rags
- Treated and/or painted wood
- Food scraps

## Learning Procedure

Place all seven items into the container representing the burn barrel. Ask seven students to each remove one item from the "barrel." Each item provides discussion topics covered in the preceding text. It may help to write the following questions and answers on flash cards.

- **DIAPER** – **Ask:** What do you think happens when a disposable diaper is burned? **Answer:** Plastics cause toxic air pollution, etc. In fact, ANY kind of burned plastic – like bags and toys – creates toxic air pollution. Discuss acrid smells of burning plastic. Hold up the disposable diaper. **Ask:** Can you think of ways to eliminate the need to burn a diaper? **Answer:** Landfill them or use cloth diapers.

- **NEWSPAPER AND WHITE PAPER** – **Ask:** What do you think happens when paper is burned? **Answers:** Particulate matter can get into the lungs and a natural resource that could have been recycled is destroyed. In addition, some paper is coated and is toxic when burned. **Ask:** What about glossy paper from magazines? **Answer:** The coatings and ink can contain harmful chemicals and metals. (This is a good time to mention asthma and other lung diseases. Ask students if they know anyone with breathing problems? Ask them if they've ever gotten close to a burn pile. What happened? Coughing?) **Ask:** What are some alternatives to burning paper? **Answer:** Recycle it.

- **PIECE OF TIRE** – **Ask:** What happens when a **tire** is burned? **Answer:** Toxic gases and particulate matter are released into the air. (Mention asthma again.) **Ask:** What are some alternatives? Can tires be reused? **Answer:** Tires can be retreaded for reuse or chipped for septic tank drain fields. They also can be recycled into playground mats, soaker hoses and welcome mats. In addition, roads can be repaved using rubberized asphalt.

- **AEROSOL CAN OR BOTTLE HALF-FULL OF CLEANING SOLUTION** – **Ask:** What happens when these items are burned? **Answer:** Toxic vapors are released into the air. **Ask:** What are alternatives to burning them? **Answer:** Many recycling programs accept aerosol cans with scrap metal. For bottles of cleaning solution, use it all and recycle the empty bottle. If you don't need to use anymore, give it to someone else to use.

- **GREASY RAGS** – **Ask:** What happens when these are burned? **Answer:** Toxic vapors are released into the air. **Ask:** What are alternatives to burning them? **Answer:** Wash and reuse them.

- **TREATED AND/OR PAINTED WOOD** – **Ask:** What happens when this is burned? **Answer:** Toxic gases and particulate matter are released into the air. **Ask:** What are some alternatives? **Answer:** Reuse or donate it to charity. Check with your county recycling program. **Ask:** What about regular wood? (Pull out a piece of board.) What can you do with it instead? **Answer:** Reuse it.

- **FOOD SCRAPS** – **Ask:** Instead of burning them, what are some alternatives for disposing of food scraps? **Answer:** They can be composted. **Ask:** What are some uses for compost? **Answer:** Compost is a good soil amendment for gardens and flower beds.

## Questions for the Class

- How does your family dispose of its garbage? Do you recycle?
- Do you ever see your family or neighbors burn garbage?
- Who has a burn barrel at home?
- How many of your friends or relatives have a burn barrel or burn pile?
- How many of you help your family and friends burn garbage?
- What have you seen burned in burn barrels? (Let students give different examples.)
- If you choose to burn, what is OK to burn? When is it OK to burn?
- Why should you not burn items such as plastic, aluminum or household garbage?
- What are some alternatives to burning?

## Resources

- S.C. Forestry Commission Web Site – **www.state.sc.us/forest/fire.htm**
- "Learn Before You Burn" brochure – **www.scdhec.gov/administration/library/ML-025314.pdf**

**Student Handout**

# POLLUTION CHART

| ITEM | POLLUTANTS GIVEN OFF DURING BURNING | ALTERNATIVE(S) |
|---|---|---|
| **Dirty diaper; plastic grocery bag, plastic containers** | Cancer-causing chemicals and metals; acid gases such as hydrochloric acidic vapor | Use cloth diapers. Recycle plastic containers. Recycle grocery bags. Use canvas bags when shopping. |
| **Newspaper; white notebook paper** | Carbon Monoxide; small particulate matter; cancer-causing chemicals | Recycle. |
| **Glossy magazine** | Toxic chemicals and heavy metals; Carbon Monoxide; small particulate matter | Recycle. |
| **Tires** | Cancer-causing chemicals such as heavy metals and dioxins; acidic gases; lead (which adversely affects children's intellectual development; Carbon Monoxide and small particulate matter contained in black, oily smoke | Recycle – it's the law! |
| **Aerosol can; bottle of household cleaner** | Chemicals in the can or bottle are released in smoke. Chemicals in the can or bottle make new toxic gases when burned. Aerosol cans can explode when heated and metal shrapnel can shoot out of the barrel. | Recycle aerosol cans; use all cleaners or give them to someone else to use. Then recycle the empty containers. |
| **Greasy rags** | Carbon monoxide; small particulate matter | Wash and reuse. |
| **Treated and painted wood** | Arsenic – a poison and can cause cancer – is released into the air; carbon monoxide; small particulate matter | Reuse. Use larger pieces to build bird houses, etc. |
| **Clean wood** | Carbon Monoxide; small particulate matter | Reuse. |
| **Dry leaves** | Chemicals known to irritate the respiratory system | Compost. |
| **Food scraps** | Carbon Monoxide; small particulate matter | Compost. DO NOT include meat and dairy products. |

# THE GREENHOUSE EFFECT

**PREPARATION TIME: MODERATE**

## Learning Objectives

Students will:

- understand that the atmosphere traps heat and makes the surface of the Earth warm enough for life;
- recognize that air pollution can cause a rise in temperature and ecological decline; and
- recognize that human activities can cause air pollution.

**NOTE TO TEACHERS:** This activity introduces the concepts of climate change and the "**greenhouse effect**." Thinking through the possible effects of **global warming** upon plants, sea levels and the world's food supply may cause the students to better appreciate how complex a role the atmosphere plays in our lives.

## Background

The greenhouse effect is a term scientists use to describe the trapping of heat on the surface of the Earth by the atmosphere – a normal atmospheric occurrence. As a result, the Earth's surface is about 53°F (12°C) warmer than it would be without this trapping. This effect is magnified by certain **greenhouse gases** in the atmosphere, most notably **carbon dioxide**, **methane**, nitrogen oxides and **chlorofluorocarbons** (CFCs).

Methane is a product of natural decay from living (or once living) things; nitrogen oxides are generally a result of man-made burning, automobile and similar internal-combustion engines; and CFCs are a class of chemicals often used in air conditioners, refrigerators and as the pressurizing gas in aerosol spray cans. While all of these pollutants contribute to air pollution and contribute to the greenhouse effect, carbon dioxide is the most important greenhouse gas.

Scientists believe that concentrations of greenhouse gases in the atmosphere will double over the next hundred years, producing average temperature rises of about 8 -10°F (4 -6°C). While most scientists believe that the greenhouse effect will gradually warm the Earth's climate, there are some who believe that increased cloud cover will eventually reflect more sunlight away from the Earth and lower the average temperature. This increased reflectivity is called the Earth's **albedo**.

*Continued on the following page*

## Learning Essentials

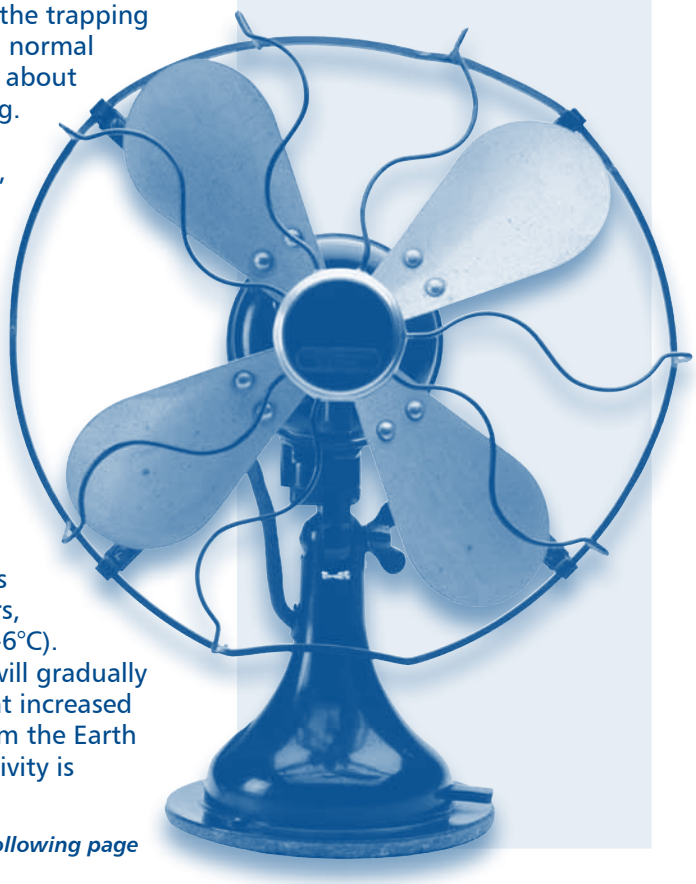
**Focus:** Greenhouse effect, air pollution

**Subject:** Science

**Materials:** Two clean, dry wide-mouth jars with lids (like mayonnaise jars), heavy aluminum foil, a piece of dark cloth or construction paper, a stop watch or watch with a second hand, two identical thermometers that fit into the jars (meat thermometers work well), paper, pencils

**Teaching Time:** 20 minutes with possible extensions

**Vocabulary:** Albedo, carbon dioxide, chlorofluorocarbons, global warming, greenhouse effect, greenhouse gases, methane



## Learning Procedure

1. Divide the class into two groups. Give each group one of the jars. Have each group put a piece of dark cloth or paper into their jar. Have them put a thermometer in each jar so that the scale can be read through the side. Have one group screw the cover onto their jar. Have the other group leave their jar open.

2. Have the groups place the jars on their sides in sunshine so that their bottoms face the sun.

3. Instruct each group to watch the thermometers and have one person from each group record the temperature in their jar every minute. Instruct the group with the closed jar to announce when the thermometer in its jar levels off or reaches 140$^0$F (60$^0$C). Stop the experiment at that point.

4. Have the students discuss the following questions:

   - In which jar does the temperature rise fastest?
   - How much faster did it rise? Why?
   - How is this like a greenhouse?
   - How is this like the real Earth's atmosphere?
   - What was the role of the dark cloth in the jars?

## Extension Activities

Have students wrap one of the jars with aluminum foil, leaving a clear area away from the sun to read the thermometer. Repeat the experiment and compare the times to reach 140$^0$F (60$^0$C). Discuss why it took longer.

Have students try the experiment on a cloudy day. Discuss the difference in results. Have them try the experiment without the dark cloths and discuss the difference in results.

This lesson was adapted from the U.S. Environmental Protection Agency's "Project A.I.R.E. – Air Information Resources for Education (K-12)."

## Suggested Reading


Thornhill, Jan. "This Is My Planet: The Kids' Guide to Global Warming." September, 2007.

Nye, Bill, Terry Marks and Tom Owen. "Bill Nye the Science Guy's Big Blast of Science." September, 1993.

Taylor, Barbara and Scoular Anderson. "How to Save the Planet." August, 2002.

# STICK 'EM UP

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- learn that tiny particles are forever floating around in the air we breathe; and
- collect, observe and analyze these particles from various locations around their school or community.

## Background

The air around us is invisible. It is made up of gases that cannot be seen. Many major air pollutants also are invisible gases. In some areas of the country, these air pollutants can build to levels where they can be seen. For example, in some cities, smoky, yellowish clouds of primarily car exhaust build up to create **smog**. Other easily visible air pollutants, called **particulate matter**, are made up of tiny particles of solids or droplets of liquids. Some of these particulates are naturally occurring and may pose less of a problem to human health than man-made particulates. Some natural particulates include pollen, wind-blown dust and volcanic ash. Man-made particulates are generated by coal- and oil-fired power plants as well as manufacturing plants, automobile and diesel fuels as well as fireplaces and wood-burning stoves among others. These **airborne** particulates, or particles carried through the air, can be harmful to plants, animals and humans. Buildings and statues can be discolored.

## Questions for the Class

1. Can we see air pollution? How do we know that air pollution exists?
2. Give examples of visible air pollution.
3. Discuss the concept of particulate matter.
4. List some sources of air pollution, both visible and invisible. Can a single source provide both visible and invisible air pollution?

## Materials

- Clear packaging tape
- Hole punch
- Magnifying glasses (microscopes optional)
- Marker
- Scissors
- "Stick 'Em Up" Collector Diagram
- String

*Continued on the following page*

## Learning Essentials

**Focus:** Airborne pollutants

**Subject:** Science

**Extension:** Social Studies

**Materials:** See the list provided

**Teaching Time:** Two class periods about a week apart

**Vocabulary:** Airborne, particulate matter, smog

## Learning Procedure

1. Copy the "Stick 'Em Up" Collector Diagram so that each student has a particulate collector.

2. Cut four holes ± 1.25 inches in diameter in the strip as marked. Using the hole punch, make a hole in the top and tie the string into a loop.

3. Cover one side of the strip with clear tape so that the holes are covered on one side. DO NOT TOUCH THE STICKY SIDE OF THE TAPE SHOWING THROUGH THE HOLES.

4. Select different sites around the school to hang the "Stick 'Em Up" Collectors. On each strip, write the student's name, location, date and time it is hung. Site selections may include your classroom, the hall outside your classroom, the gym, bathrooms, the cafeteria, the office, the teacher's lounge, outside near a tree, near the parking lot, etc. The collectors should be placed where they can hang freely – not touching other surfaces and where they will not be touched by other students. Be sure to let the custodial staff know about your experiment, too.

5. After a week, retrieve the "Stick 'Em Up" Collectors and analyze. Have the students make a quick inspection, reviewing the strips with the naked eye. What did they find? Next, have them inspect the strips with the magnifying glass or a microscope. What do they see?

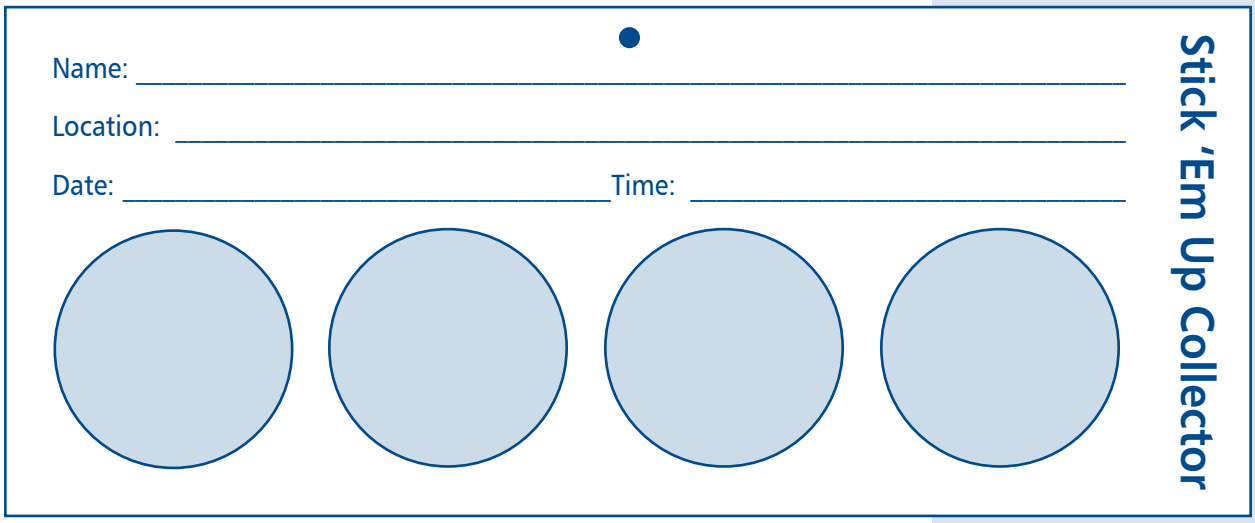
## Extension Activity

Make a traffic survey. Pick a location where students can observe a busy intersection from a safe distance.

Separately record the number of trucks, cars, buses and vans that pass through that intersection in a given hour. Repeat the activity for several days at different times during the day.

- **Ask:** What factors influence volume of traffic? (e.g., locations of highways, number of people, shopping centers, businesses, special events, etc.)
- **Ask:** Did you see evidence of air pollution? (e.g., odors, smoke, wilted plants struggling to survive etc.)
- **Ask:** Do you think this is a problem? Why or why not. If so, what do you think should be done to correct it?

## 'Stick 'Em Up' Collector Diagram



# TEMPERATURE INVERSION

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- learn about temperature inversions;
- observe how they develop; and
- see their effect on local weather.

## Background

In a normal situation, temperature decreases as you rise into the atmosphere. The warmer air would be closer to the Earth's surface and the cooler air would be above it. The rate of decrease varies, but an accepted average value, also known as the normal lapse rate, is $6.5^0$ C per 1,000 meters or about $35^0$ F per 1000 feet.

A **temperature inversion** is not a normal situation. In this case, temperature increases with altitude in the atmosphere. Since cold air tends to descend relative to warm air, vertical motion is suppressed resulting in warmer air aloft and holding a layer of cooler air beneath it – often near the Earth's surface. Air pollution released from automobiles, industry and smokestacks can become trapped and prevented from rising and dispersing with the winds. Typically, warmer air rises and cold air descends, but in this situation, the air masses do not move. This is called an **inversion**. Because high-pressure systems often combine with temperature inversion conditions and low wind speeds, their long residency over a heavily polluted area may result in an episode of severe smog.

There are two conditions that cause an inversion to develop. One is when a low-level or surface inversion takes place on a clear night and the Earth's surface radiates heat rapidly. If the air is clear, the ground and the air directly above it can be cooler than the air at higher altitudes.

Another involves an inversion elevated a few to several hundred feet above the ground. It develops in response to regional patterns of atmospheric pressure and circulation rather than local conditions. It rises when high pressure over the northeastern U.S. drives a cold northeasterly flow at the surface underneath a warmer, often southwesterly, flow. Locally, this is known as a "**wedge**," since the colder, denser air wedges itself underneath the less dense warm air aloft. The elevated inversion layer acts as a lid to prevent air and pollutants from rising higher in the atmosphere. If the wedge reaches

*Continued on the following page*

## Learning Essentials

**Focus:** Temperature inversions and how pollutants react to them

**Subject:** Science

**Extensions:** Math, Geography

**Materials:** Large glass jar with lid, warm water, syringe, cold water, ice cubes, food coloring, white paper

**Teaching Time:** One class period

**Vocabulary:** Inversion, temperature inversion, wedge

the Southern Appalachians, the mountains can act like a dam to help trap the pool of cold air. A change in the large-scale weather pattern is usually required to break up the wedge and its associated inversion.

Conditions in South Carolina frequently favor the development of temperature inversions, especially near the surface during overnight periods. Although these inversions are transient, trapped pollutants can become quite concentrated until inversion breakup after sunrise. The inversions that form above the wedge occur much less frequently, but can persist for days until a change in the weather pattern breaks them up. While pollutant concentrations can build up as the wedge persists, winds typically help disperse the pollutants horizontally, especially at the surface.

## Learning Procedure

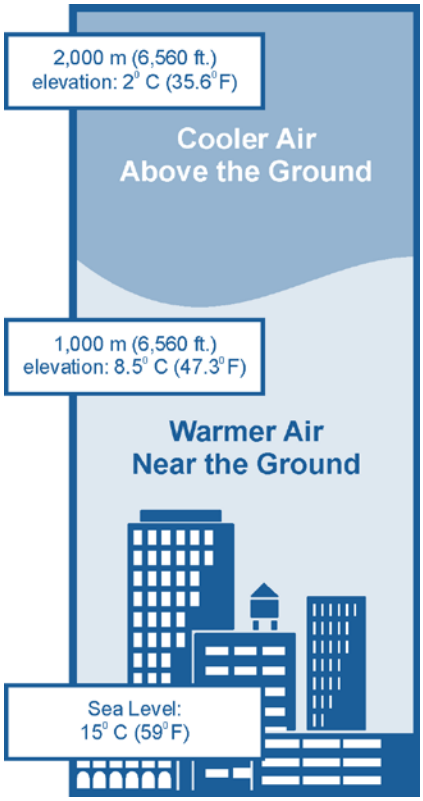
### EXPERIMENT #1

The following experiment will replicate a typical atmospheric condition related to air pollution.

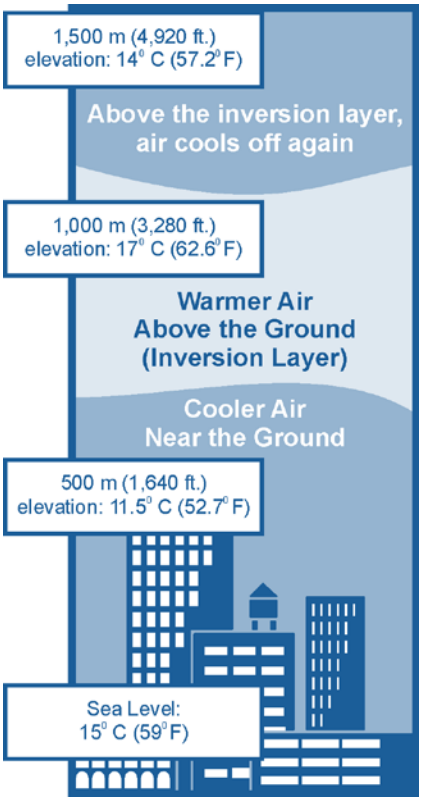
1. To create a typical atmospheric condition, add a few drops of food coloring to a cup of warm water. The food coloring is used to represent air pollution.
2. Fill a glass jar about 2/3 full with cold water and add several ice cubes.
3. Fill a syringe with the warm, colored water.
4. Remove the ice cubes from the jar. Slowly add the warm, colored water to the bottom of the cold water in the jar using the syringe. As the warm water rises it should mix with the cold water.
5. Put a piece of white paper behind the container to make it easier for the students to see the water in the container.

This experiment shows that under typical atmospheric conditions, air pollution (the colored water) eventually moves up and mixes in the atmosphere. The warm, colored water mixing with the cold water as it rises represents the mixing of warm and cold air. The air masses are able to move under typical atmospheric conditions.

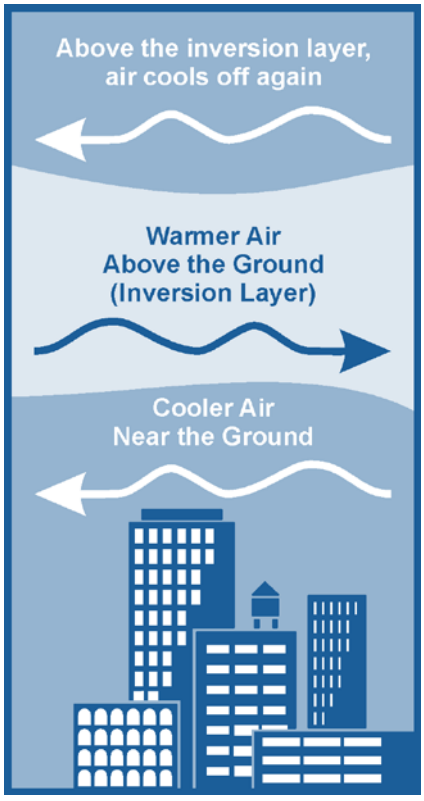
**NORMAL LAPSE RATE**
(Temperature decreases as altitude increases.)




**TEMPERATURE INVERSION**
(Temperature increases as altitude increases.)




**VERTICAL PROFILE**
(This graphic shows the direction of air currents during an inversion.)



**EXPERIMENT #2**

To show students a temperature inversion related to air pollution, conduct the following experiment.

1. To create a temperature inversion, fill a glass jar with hot water.
2. Fill a separate small container with cold water (add ice cubes to make it cold) and add food coloring (air pollution).
3. Fill a syringe with the cold, colored water.
4. Slowly add the cold, colored water to the bottom of the jar through the syringe.
5. Place a lid on the container to represent a high-pressure system over the atmosphere.
6. Put a piece of white paper behind the container to make it easier for the students to see the water in the container.

This experiment shows that during a temperature inversion, air pollution (the colored water) becomes trapped in the lower atmosphere.

The air pollution is trapped because the warm air above traps the cold air (with the pollution) and the high-pressure system bears down on the atmosphere so the air masses can't move. The only way the air pollution can dissipate is for the weather system to change allowing the air to move again.

## Reference

"Consider the Earth, Environmental Activities for Grades 4 through 8," Julie M. Englewood: Teacher Ideas Press, 1989.

## Acknowledgment

This lesson is adapted from Gilbert D. Perez, University of Texas at El Paso TES Course, 1995

MATH
HISTORY
SCIENCE

# THIS IS THE WAY WE USE OUR AIR

| PREPARATION TIME: | MODERATE |
|---|---|

## Learning Objectives

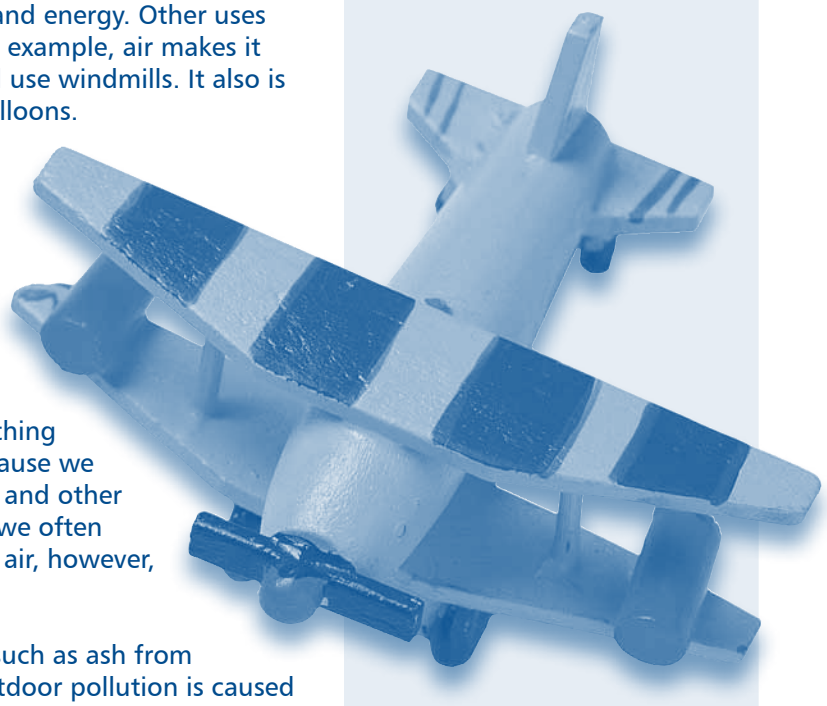
Students will:

- name some ways that people use air;
- describe some ways that people pollute air; and
- name some things people can do to help keep the air clean.

## Background

Air is important to us for many reasons. It is important to humans and animals because air carries the **oxygen** we need to live. Air also makes fire possible, which provides us with heat, light and energy. Other uses of air make our lives easier or more pleasant. For example, air makes it possible to sail sailboats, fly kites, fly aircraft and use windmills. It also is used to dry clothes as well as inflate tires and balloons.

Clean air, which is composed of nitrogen, oxygen and other gases, is healthy for us to breathe. But air – both indoor and outdoor – can become polluted – that is, contaminated with particles and gases that are not part of its natural composition, making the air dirty and unhealthy. Air also can become unhealthy with excessive amounts of gases that are part of its natural composition. In other words, a good thing can become a bad thing if it exists in excess. Because we sometimes see and/or smell smog, odors, smoke and other evidence of air **pollution** when we're outdoors, we often associate pollution only with outdoor air. Indoor air, however, can be just as dirty and polluted as outdoor air.



Some outdoor pollution is from natural causes, such as ash from volcanoes and smoke from forest fires. Other outdoor pollution is caused by such things as dirt from big farms during plowing, smoke from woodstoves, exhaust from cars and fumes from factory smokestacks. Some air pollution cannot be seen or even smelled. Indoor air can be polluted by such seemingly innocent items as outgassing from plywood; glues; fireplaces; emissions from synthetic materials; woodstoves; paints;

*Continued on the following page*

## Learning Essentials

**Focus:** How people use air, how air gets polluted, what can be done to keep air clean

**Subject:** Science

**Extensions:** Language Arts, Social Studies, Writing

**Materials:** Copies of the student worksheets (included), crayons, community map, magazines, flip chart, chalkboard or SMART Board

**Teaching Time:** Two or three class periods

**Vocabulary:** Oxygen, pollution, pollution prevention

pesticides; cigarette, cigar and pipe tobacco smoke; as well as cleaning and hygiene products. Biological contaminants, such as mold, mildew, bacteria, viruses, pollen, dust mites and animal dander also can occur in high concentrations indoors.

We can do a lot, individually and collectively, to help keep the air clean. Air pollution devices installed in factories, power plants, vehicles and woodstoves help trap pollutants before they get into the air. The use of cleaner-burning fuels and more advanced combustion technology are other ways that pollution is being reduced. Other efforts include encouraging people to use cars less and to conserve electricity, which will reduce the amount of fuel we burn and at the same time reduce the amount of pollutants we put into the atmosphere.

There is a great deal of emphasis today on these types of **pollution prevention** activities because it is often easier and less expensive to prevent pollution than to clean it up. Reusing material in our homes, offices and factories; reducing our consumption of materials that cause pollution; using less-polluting materials; and recycling used materials are some ways to help accomplish this goal of keeping our air healthy.

## Learning Procedure

1. Ask the students to list ways in which we use air. Write their answers on a flip chart, chalkboard or SMART Board.

2. Ask the students if air is always clean. (No.) Ask them if they know of any ways in which air is made dirty. (Accept all reasonable answers.)

3. Students can make their own student worksheets by drawing a picture showing examples of things that use our air as well as things that pollute our air. How does the student drawing show clean air and how is air being used? Ask the students to take turns sharing their pictures and explaining what it is.

4. Discuss ways that people can control or change the air quality in their houses. Examples include furnaces, woodstoves, portable heaters, air conditioners, portable fans, ceiling fans, humidifiers, taking a shower or bath, opening/closing windows and doors, number of windows, air cleaners, air fresheners, smoking a cigarette, pets, baking cookies, cooking on a stove, etc. Have the students look for pictures of these examples in magazines. Develop an interactive bulletin board or learning center to categorize the pictures into four groups: temperature; movement; humidity; and smell.

## Extension Activities

1. Hold a classroom discussion about the differences in the air quality around your school and in your community. Make a rough map of your community, including the school, on a sheet of paper and make copies for your students. Include (where appropriate) drawings of trees, wooded areas, gardens, compost piles, water bodies, etc., to indicate things that, for the most part, help keep the air clean. For younger students, instead of making a community map you can make a map using a one-mile radius around the school.

   The purpose is to show potential sources of air contaminants and include examples such as:

   - highways or parking lots with cars (e.g., auto emissions);
   - factories (e.g., smokestack emissions);
   - logging operations (e.g., sawdust, dust from dirt roads);
   - mining operations (e.g., mineral dust, dust from dirt roads);
   - tractors (e.g., burning of fossil fuels), crops (e.g., dust kicked up during planting/harvesting, pesticides, fertilizers, weed killers), livestock (e.g., smell of animals and their waste), crop-dusting by airplanes;
   - dry cleaning businesses (e.g., chemicals);
   - a house with all of the lights on (e.g., using too much electricity);
   - gasoline or service stations and body/paint shops (e.g., chemicals called hydrocarbons escape when pumping gas, welding/soldering activities, chemicals from painting/body work, chemicals escape from automobile fluids as they are being replaced or added, chemicals in automobile air conditioners may deplete ozone layer, etc.);

- oil refineries or power plants (e.g., burning of fossil fuels);
- highway construction activities (e.g., dirt/dust, heavy machinery that burn fossil fuels);
- residential construction or remodeling (e.g., chemicals from paints and glues, sawdust and dirt clouds, power tools use electricity);
- landscaping (e.g., chemical – pesticides, fertilizers, weed killers – entering the air, dust or dirt clouds);
- a burn barrel burning leaves, etc. (e.g., smoke); and
- airports (e.g., loud noise from airplanes, aircraft exhaust, solvents, maintenance fluids, cars and buses traveling to and from the airport).

2. Lead the students to see how many of their community's daily activities contribute to air pollution. Point out that a lot of air pollution is a direct result of our current life-styles. Solicit ideas about ways to reduce air pollution in their community.

3. Have the students cut out magazine pictures showing different ways that people use air. Make a collage for your classroom. Another option is to make a collage showing ways that people pollute air.

4. Collect the student worksheets from the students and make a classroom display. Make copies for children to take home or you can display them during your school's open house. Students also can make their own creative writing booklet with the student worksheets.

5. Older students can write stories about how people use air, pollute the air and ways to reduce air pollution.

## Resources

- Crowell, Thomas Y. "Air is All Around You." Harper and Row, 1962.
- Kalman, Bobbie and Janine Schaub. "The Air I Breathe - Primary Ecology Series." New York: Crabtree Publishing Co., 1993.
- $B^2$ (Breathe Better Air): An Anti-idling/Clean Air Campaign Web Site – **www.scdhec.gov/b2**
- Green Steps Schools Plant Labels at **www.greenstepschools.com/greensteps/pdf/plant_labels.pdf**

MATH
HISTORY
SCIENCE

# TODAY'S FORECAST...

**PREPARATION TIME: MODERATE**

## Learning Objectives

Students will:

- study typical weather patterns in South Carolina; and
- observe the impact of weather on air quality.

## Background

Weather patterns are the single most important factor in the movement of airborne air pollutants. In South Carolina, stagnant air is a prevalent phenomenon that often results in hot humid weather during the summer months. **Stagnant** air traps air pollutants, keeping them in one place. The cause of stagnant air is a result of South Carolina's geographical location in relationship to prevailing weather patterns.

"We all live downwind" is a saying that has particular relevance in South Carolina. Airborne pollutants can travel great distances downwind. Some of the air pollution found in South Carolina comes from the Midwest and the Ohio Valley. These pollutants are the ones that can travel and contribute to the formation of **ground-level ozone** along with pollutants already in the area. Ground level-ozone is formed when volatile organic compounds such as gas vapors and solvents, and oxides of nitrogen such as exhaust and smoke, mix with heat and sunlight. Ground-level ozone is a concern during the hotter months of the year.

The **topography** of South Carolina is divided into two distinct areas commonly known as the Piedmont and the Coastal Plain. The **fall line** dividing these two regions runs northeast from Aiken County through Chesterfield County to the North Carolina border and beyond. Elevations range from about 400-500 feet above mean sea level (msl) along the line and increases to more than 3,000 feet above msl in the extreme northwestern counties. Sassafras Mountain in Pickens County, for example, has an elevation of 3,500 feet above msl. Moving east from the fall line, elevations decrease to mean sea level along the coast.

East of the line there is evidence of outcroppings from the lower Appalachian mountains in a ridge of low hills and broken country between the Congaree River and the northern fork of the Edisto River. They also are seen in a rather hilly and rolling region in the upper

*Continued on the following page*

## Learning Essentials

**Focus:** How airborne pollutants are affected by weather patterns

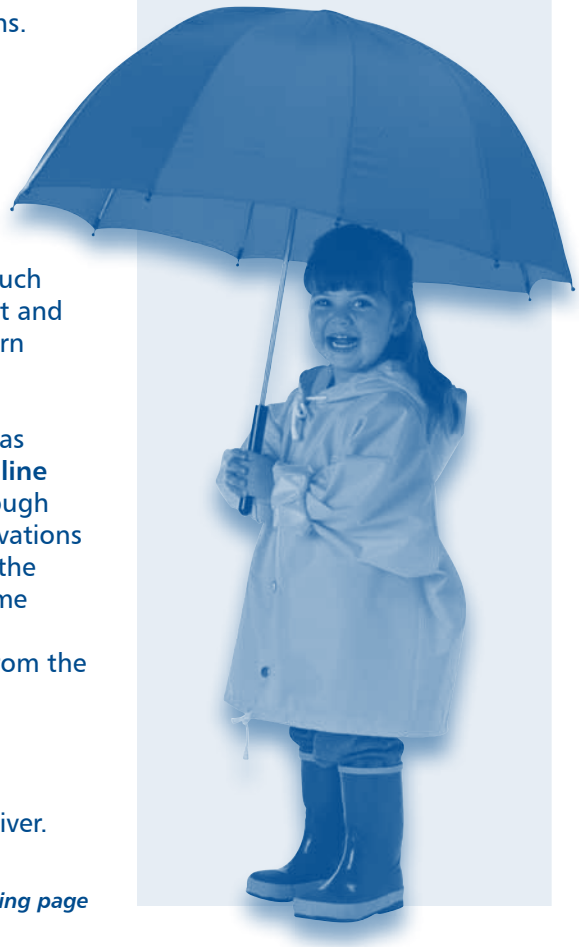
**Subject:** Science

**Extensions:** Geography, Social Studies

**Materials:** See the list provided

**Teaching Time:** One class period and five days of observation

**Vocabulary:** Air Quality Index, altitude, disperse, fall line, ground-level ozone, lapse rate, stagnant, temperature inversion, topography



Lynches River drainage basin between the Catawba-Wateree and the Great Pee Dee Rivers. In the lower coastal region to the east and south, great swamp systems predominate.

The slope of the land from the mountains to the sea is toward the southeast and all of South Carolina's streams naturally flow toward the Atlantic Ocean. The South Piedmont section of South Carolina is on the eastern slope of the Appalachian Mountains. To some extent, these mountains act as a barrier for the wind and tend to protect the area from the full force of cold air masses during winter months. The relatively flat areas of the Central Plains and coastal region allow free movement of air and effectively **disperse** pollutants.

The degree to which airborne pollutants build up depends largely on the weather. For instance, measured concentrations of local air pollutants may vary markedly with changing weather even though the total discharge of pollutants remains relatively constant. To evaluate the role that the weather plays in dispersing airborne pollutants, it is important to consider large and small-scale weather patterns. Large scale patterns can usually be determined from the climatological evaluations of existing weather records available from most National Weather Service Stations. Small-scale weather patterns, on the other hand, are not always easily defined because they depend on various local influences.

Factors that determine how the weather can disperse air pollution include:

- wind speed, direction and turbulence;
- stability or, more generally, the resistance to vertical motion of the lower layers of air; and
- humidity including condensation such as fog.

The success of wind in moving and dispersing air pollution is based on wind speed. The faster the wind, the faster and more widely air pollutants are dispersed. Wind direction – with its variations – plays an important role in the way pollutants move.

Stagnant air masses occur with varying frequencies in the country. South Carolina experiences one of the highest frequencies of stagnant air in the Eastern United States. Stagnant air masses can produce air pollution episodes.

Stability plays an important role in the weather's relationship to air pollution. Temperature change and altitude determine the stability of the atmosphere. Temperature normally decreases the higher you go in the atmosphere. This is called the **lapse rate**.

Remember – warm air rises. If lower **altitude** air temperature is close to the temperature of air in higher altitudes, then more energy than normal is needed to move air in its natural cycle from closer to the Earth to the upper atmosphere. When warmer air is at a higher altitude than cooler air, this is called a negative lapse rate – or **temperature inversion** – that keeps the cooler air closer to the ground from moving to higher altitudes. A temperature inversion can trap air pollutants near the Earth's surface, keeping them from being dispersed – or spread out – over large areas. Shallow temperature inversions near the Earth's surface may be produced nightly with light winds under clear skies. This type of inversion usually breaks up in the late morning as air near the Earth warms. If the temperature inversion reaches into higher altitudes, solar heating during the day may not be enough to break up the inversion. South Carolina has a 45 percent chance of inversion on an annual basis.

The role of humidity – including condensation such as drizzle, snow or rain – does not have as great an effect as wind and stability. Condensation – as a result of high humidity – may cause "rain out" or the removal of gaseous air pollutants and particulate matter. Fog, however, usually limits solar heating that slows down the warming of air closer to the ground and slows down the break up of temperature inversions. Air pollution also may have a direct effect on weather since it can provide particles around which fog may form.

Investigations of air pollution episodes have found all of these weather elements are contributing factors for the accumulation of unusually high concentrations of air pollutants. Light winds, stable conditions and brief periods of fog occurring at the same time is not a rare occurrence – especially in hilly country. Experience suggests that conditions must persist for several days before high concentrations of air pollution occur. Such persistent periods are usually associated with the prolonged stagnation of high pressure systems. In the summer, the Bermuda High is the greatest single weather factor. This permanent high usually blocks the entry of cold fronts into South Carolina.

Meteorologists use the **Air Quality Index** to classify and measure contaminants in the air and report conditions to the public. The index is used to convert data from air monitoring stations at various locations around a community to a scale that indicates the potential effects of measured levels of various contaminants including the effect of pollutants on human health, property and vegetation.

## Materials

- Five different colored markers
- Weather maps or the weather forecast for an entire week
- Wind speed (optional) and direction indicator
- Thermometer
- Barometer

## Learning Procedure

1. Review with the class the background material provided with this lesson.

2. In a wide open space on the school grounds, set up the wind speed and direction indicator, thermometer and barometer. Assign students to record the data from these instruments twice a day – once in the morning and once in the afternoon – for 5 days on the "Weather Log" Student Worksheet.

   NOTE: A wind speed indicator may not be available and can be omitted. You may use a simple weather vane and compass for the wind direction indicator. Or, they can get the weather patterns information from the Internet.

3. Divide the class into six small groups. Give each group a weather variable (e.g., temperature, humidity, pressure, wind direction, wind speed, precipitation) and have them plot it on a graph. The information can be gathered from the running weather log. Weather patterns are available on the Internet. For each variable use a different color marker. Be sure to record temperature extremes and – if possible – pressure readings.

4. Take 10 minutes during each class to call attention to the status of the weather log and give the students a few questions in preparation for the discussion at the end of the exercise. Sample questions are provided below:

   - Would you expect some aspects of the weather to have more (or less) influence on the quality of the air we breathe? If so, which ones and why?

   - The Air Quality Index is usually expressed for particular contaminants – such as ground-level ozone and particle pollution. From your observations, does it appear that changes in weather have more (or less) effect on air quality for some contaminants?

5. During one of the classes near the end of the data collection period, give the students a few additional questions to address in their presentations to the class. For example:

   - How would you describe the weather in our state?

   - Do the weather patterns in our area seem to have an effect on pollution? If so, what effects?

   - Are the effects always negative?

   - What types of weather patterns would help air quality?

## Questions for the Class

1. How accurate were the published accounts of the weather compared to the readings from the school yard? Were they different? Why?

2. How do weather patterns spread air pollution over a large area? Is this good or bad?

3. We can't alter the weather. How can we reduce the effect of airborne pollutants?

4. Who lives and works upwind? What pollutants do they produce?

5. Who lives and works downwind? What pollutants does your community produce that travel downwind?

**Student Worksheet**

Name: _____

# WEATHER LOG

| TIME | DAY 1 | | DAY 2 | | DAY 3 | | DAY 4 | | DAY 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AM | PM | AM | PM | AM | PM | AM | PM | AM | PM |
| TEMPERATURE | | | | | | | | | | |
| BAROMETRIC PRESSURE | | | | | | | | | | |
| WIND DIRECTION | | | | | | | | | | |
| WIND SPEED (optional) | | | | | | | | | | |

OBSERVATIONS:

# RECYCLING: IT'S AN ENERGY ISSUE

| PREPARATION TIME: | MODERATE |
|---|---|

## Learning Objectives

Students will:

- understand embedded energy;
- identify how energy becomes embedded in a product;
- calculate the percent of energy saved by recycling materials versus processing virgin materials; and
- conclude that recycling saves embedded energy.

## Background

The energy used to manufacture a product is a direct energy cost. But there are indirect energy costs, too. The energy used to obtain **raw materials** – for transportation, distribution and even the disposal of an item – contributes to indirect energy costs.

Direct and indirect energy costs are referred to as **embedded energy** – the total amount of energy a product uses in its "life." Both direct and indirect energy costs can be reduced through **recycling**. The "Energy in Waste Scenarios" Student Handout provides estimates of how much embedded energy can be saved by recycling certain products.

## Materials

- "Energy in Waste Scenarios" Student Handout
- "The Environmental Effects of Resource Use" Student Handout
- "Energy in Waste Analysis" Student Worksheet

## Learning Procedure

1. Write "ENERGY" on the board. Ask students for examples of different kinds of energy (light, heat, mechanical, chemical, nuclear and electrical, etc.). Write "DIRECT ENERGY" and define it as the energy it takes to manufacture a product or provide a service.

2. Write "INDIRECT ENERGY" on the board. Define it as the energy used to make and move products that is not directly involved in the production process.

*Continued on the following page*

## Learning Essentials

**Focus:** Energy awareness, economics of recycling

**Subject:** Science

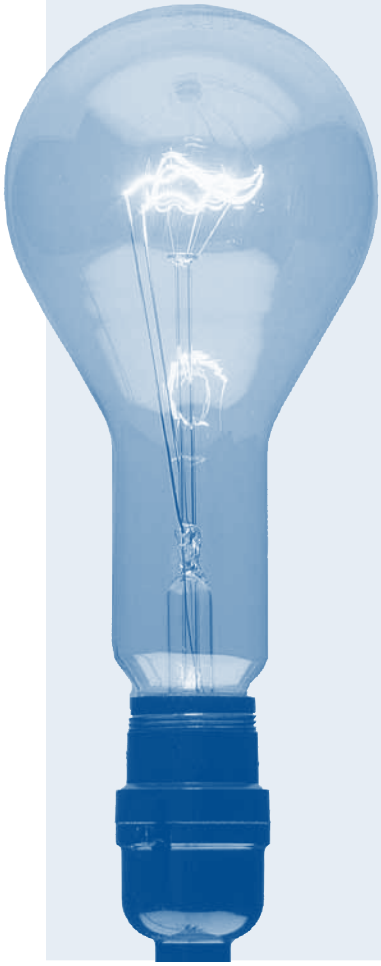
**Extension:** Math

**Materials:** See the list provided

**Teaching Time:** One class period

**Vocabulary:** Btu, embedded energy, raw materials, recycling

**Lesson Resources:** "Natural Resources," "Recycling 101"



3. Write "EMBEDDED ENERGY" on the board. Ask students to develop a definition of the term. Remind students that all matter contains energy. Once something is moved or manufactured, it also has embedded energy. The amount of embedded energy depends on the amount of processing involved. Point out that embedded energy costs are very useful when scientists are evaluating different processing or manufacturing options.

4. Distribute "The Environmental Effects of Resource Use" Student Handout. Discuss each of the three steps involved in resource use. Have students identify how direct and indirect energy is used during each step. Point out the environmental effects of each step.

5. Divide the class into groups of four students. Give each group a copy of the "Energy in Waste Scenarios" Student Handout. Give each student a copy of the "Energy in Waste Analysis" Student Worksheet.

6. Have the students read each scenario and complete the chart for each category of waste. Each student should calculate the percentage of energy savings and identify sources of embedded energy (direct and indirect) in both new materials and recycled stock. You may want to have one student in each group act as the reader while the other students record the information.

7. A British thermal unit (**Btu**) is the amount of heat energy required to raise the temperature of 1 pound of water by 1 degree Fahrenheit at sea level.

   Review the procedure for calculating percentage.

   **STEP 1:** (Energy costs for new materials) – (Energy costs for recycled materials) = (Energy Saved)

   **STEP 2:** {(Energy saved) ÷ (Energy cost for new materials) x 100} = (Percent of Energy Saved)

   EXAMPLE: To make copper from ore requires 280 million Btu per ton; to make copper from scrap requires just 10 million Btu per ton. This is a savings of 270 million Btu per ton (280 – 10 = 270) and 270 ÷ 280 x 100 = 96 percent savings.

8. After students have completed their worksheet, have them write conclusions by comparing new versus recycled materials. Conclusions must be based on their analysis of the embedded energy used or saved.

## Evaluation

1. The students will have correctly calculated the percentage of energy saved for five materials: (paper = 67 percent; glass = 6 percent; PET plastic = 88 percent; HDPE plastic = 78 percent; aluminum = 95 percent)

2. Based on the data from the worksheet, students will conclude that recycling saves large amounts of embedded energy.

## Questions for the Class

1. **Ask:** How much embedded energy is there in a car? Have students discuss the raw materials typically contained in a new car. Have students make a mural showing the embedded energy in each of the materials used to build a car.

2. Convert the energy savings from Btu to other forms of energy by using the following factors:
   - 1 gallon of gas has 124,000 Btu;
   - 1 kwh of electricity has 3,400 Btu; and
   - 1 ton of coal has 25,400,000 Btu.

## Extension Activities

Energy use and global environmental issues such as the greenhouse effect are closely linked. Have students work together to develop a chart that shows how energy use, recycling, energy, global warming and the greenhouse effect are linked. For more information, see the chapter, "All This and $CO_2$," from the book, "The Next Step: 50 More Things You Can Do To Save The Earth." Have the chart displayed in the cafeteria or other common area.

Student Handout

# ENERGY IN WASTE SCENARIOS

- **Paper** makes up 29 percent of the nation's municipal solid waste (MSW) stream.* Depending on the kind of paper being made and mill efficiency, using recycled stock reduces energy use by 25 to 75 percent when compared to using virgin pulp stock. To make a ton of newsprint from virgin pulp requires 30 million Btu; using pulp from used newsprint requires only 10 million Btu per ton.

- **Plastic** makes up 12.4 percent of the nation's MSW stream.* Plastic is ideal for recycling because it is made from fossil energy — about 30 percent oil and 70 percent natural gas. Soft drink bottles (made of polyethylene terephthalate or PET) cost about 98 million Btu per ton to make. Bottles made of recycled PET needs about 12 million Btu per ton. Another high-use plastic that has great potential for recycling is high-density polyethylene (HDPE) used to make items including milk jugs and detergent bottles. The United States produces about three times more HDPE than PET. Recycling one ton of HDPE costs about 22 million Btu. A ton of virgin HDPE costs about the same as a ton of PET.

- **Glass** makes up 4.6 percent of the nation's MSW stream.* Recycling glass usually begins with color separation followed by grinding the glass into small pieces called cullet. Energy is saved because the cullet melts at lower temperatures than new materials. To make a ton of glass from new materials requires 16 million Btu per ton; less than 15 million Btu are needed to make a ton of glass from cullet.

- **Metals** make up 9.0 percent of nation's MSW stream.* About 95 percent of the energy needed to produce aluminum from bauxite ore is saved by substituting aluminum scrap. Estimates of the energy costs for extracting a ton of aluminum from bauxite average 250 million Btu per ton; only 12.5 million Btu are needed to produce a ton from scrap. Recycling other metals produces similar energy savings.

* Percentages calculated by weight in tons before recycling.

**SOURCE:** U.S. Environmental Protection Agency's "Municipal Solid Waste in the United States: 2010 Facts and Figures"

## World Primary Energy Consumption, 2009

| COUNTRY / REGION | MILLION TONS OIL EQUIVALENT |
|---|---|
| North America | 2,664.4 |
| United States | 2,182.0 |
| Canada | 319.2 |
| Mexico | 163.2 |
| Central and South America | 562.9 |
| Total Europe and Eurasia | 2,770.0 |
| Total Middle East | 659.0 |
| Africa | 360.8 |
| Total Asia Pacific | 4,147.2 |
| WORLD | 11,164.3 |

**SOURCE:** BP Statistical Review of World Energy (British Petroleum, London, 2010)

**Student Handout**

# THE ENVIRONMENTAL EFFECTS OF RESOURCE USE

| STEPS | ENERGY COSTS | ENVIRONMENTAL EFFECTS |
|---|---|---|
| **Mining:** exploration, extraction | ? | Disturbs land; mining safety and health hazards; mine waste |
| **Processing:** transportation, purification, manufacturing | ? | Solid wastes; radioactive materials; air, water and soil pollution; noise; safety and health hazards |
| **Use:** transportation, transmission to the individual users, eventual use and discarding | ? | Noise; air, water and soil pollution; solid and radioactive wastes; safety and health hazards |

**Student Worksheet** Name: _____

# ENERGY IN WASTE ANALYSIS

| MATERIALS | (Energy costs in millions of Btu per ton) | | | | | | Sources of Embedded Energy | |
|---|---|---|---|---|---|---|---|---|
| | ENERGY COSTS (new materials) – | ENERGY COSTS (recycled) = | ENERGY SAVED ÷ | COSTS (new materials) | X 100 = | % ENERGY SAVED | New Materials | Recycled Materials |
| PAPER | | | | | 100 | | | |
| PET PLASTIC | | | | | 100 | | | |
| HDPE PLASTIC | | | | | 100 | | | |
| GLASS | | | | | 100 | | | |
| ALUMINUM | | | | | 100 | | | |
| CONCLUSIONS: | | | | | | | | |
| NOTES: | | | | | | | | |

MATH
HISTORY
SCIENCE

# CAN YOU DIG IT?

**PREPARATION TIME: MODERATE**

## Learning Objectives

Students will:

- learn the basics of composting;
- understand how composting reduces the amount of waste a household generates; and
- learn the basics of soil construction.

## Background

**Composting** is nature's way of recycling.

Composting is the natural decomposition of **organic material** (from plants and animals) such as leaves, **yard trimmings**, clippings and manure as well as fruit and vegetable scraps. Microorganisms break down this material into **compost**, a crumbly dark-colored, earthy smelling, soil-like material. That material is a nutrient rich product that can be used in your garden, flower beds and lawn.

Four basic ingredients are required for composting – greens, browns, water and air. Mixing the proper amounts of these ingredients together will provide the composting organisms (microbes and insects) with enough **nitrogen**, moisture and oxygen to break down the material effectively.

- GREENS include green leaves, fresh clippings and vegetable scraps.
- BROWNS include dead leaves, wood chips, dry twigs and paper.
- WATER is important. Too little moisture will inhibit the composting process. Too much moisture will cause the compost pile to smell. Here's a simple rule to follow – the compost pile should be as moist as a sponge.
- AIR is essential. Turn your compost pile once or twice a week to inhibit odor-causing bacteria and to speed up the composting process.

There are three main types of composting.

- Composting occurs naturally on forest floors as fallen leaves and tree limbs **decompose**. Nature replenishes itself this way without

*Continued on the following page*

## Learning Essentials

**Focus:** Composting, organic gardening, vermicomposting

**Subject:** Science

**Extensions:** Biology, Home Economics, Horticulture, Vocational Agriculture

**Materials:** Organic material containing carbon such as dry leaves and straw; material containing nitrogen such as grass clippings and green leaves; soil

**Teaching Time:** Several class periods for two weeks.

**Vocabulary:** Aerate, aeration, aerobic, anaerobic, biodegradable, carbon, compost, composting, decompose, humus, methane gas, mulch, nitrogen, organic material, vermicomposting, worm castings, yard trimmings

**Lesson Resources:** "Backyard Composting"

human intervention and returns nutrients to plants and trees.

- Composting can be done on a large-scale by municipal governments where trucks pick up yard trimmings and clippings from residents and take it to a central site where it is processed. The compost is sold or given to residents.

- Composting also can be done in your backyard or school.

Why composting? Why on Earth would anyone want to do that? There are lots of reasons.

Composting reduces the amount of garbage a household generates. Yard trimmings and food scraps make up about 25 percent of the total amount of municipal solid waste households generate nationwide according to the U.S. Environmental Protection Agency (EPA). It also is important to remember that yard trimmings are **biodegradable** as well as generally clean and given that, disposing of them in landfills is unnecessary and a waste of space.

Compost is a valuable product. Compost improves soil by increasing **aeration** (the ability of air to circulate) and water-holding capacity – which reduces the need to water and helps plants absorb nutrients. Compost also suppresses plant diseases and pests.

Compost reduces or eliminates chemical fertilizer and pesticide use. That saves money as well as helps protect the environment by reducing runoff pollution to nearby streams, rivers and lakes.

Composting saves money. You save money by buying fewer bags for garbage and leaves. You also save money by buying fewer bags of compost from retail outlets. You make your own valuable product at home for free.

## Learning Procedure
## Building a Compost Pile – Version One

Piles are useful for composting food scraps and yard trimmings together. The advantages of compost piles are that they produce compost quickly.

1. Using the following instructions, build a compost pile. Gather all the material needed to make a pile at least 3 cubic feet. Use both green and brown material. Green material (nitrogenous) provides nitrogen needed for decomposition and includes fresh yard trimmings. Cottonseed meal, food scraps, blood meal and manure also are high in nitrogen. Brown material (carbonaceous) provides **carbon** and includes dried leaves, straw and sawdust. Strive for a 30-to-1 carbon-to-nitrogen ratio. Alternating layers of brown and green material of the same thickness helps produce this ratio or you can add two parts of green material to one part of brown.

2. If possible, shred or chop the material to help it break down faster.

3. Start building the pile with a 4- to 6-inch (10- to 15-cm) base of brown material. If no food scraps are included and the pile is going to sit for more than a few weeks, use coarse material such as corn stalks for this base layer to let air into the pile. Moisten the material to the wetness of a damp sponge.

4. Next add a 4- to 6-inch (10- to 15-cm) layer of high-nitrogen material. If the greens are not fresh, sprinkle on a small amount of cottonseed or blood meal, poultry manure or other high nitrogen source. Food scraps should not include meat, dairy products, fats or oils because they attract scavenging animals. Mix the green and high-nitrogen material with the brown.

5. If you choose to use a bin to hold the compost, fill the bin. Alternate layers of green and brown material, adding water and extra nitrogen as needed until the bin is full. Mix the organic material to add air and remember to keep it moist.

6. If you build a compost pile on the ground, mix the green/fresh material with the brown/dry material. Build the pile 3 to 4 feet high and wide. As with a bin, keep it moist and aerated.

## Learning Procedure
## Changing the Conditions – Version Two

1. Using the layering and turning method described in version one, start five experimental compost piles in bins or five-gallon buckets – four with holes drilled in the sides. Label the bins/buckets

A, B, C, D and E. Then set up the following conditions for each bin/bucket:

A. Low in nitrogen
   - No high-nitrogen material
   - Keep moist
   - Mainly a brown pile

B. Not enough moisture
   - Don't water and exclude wet components
   - Use a mixture of brown and green material

C. No air (**anaerobic**)
   - Use bucket without holes
   - Do not turn
   - Keep moist
   - Use a mixture of brown and green material

D. High in nitrogen (grass clippings)
   - No carbonaceous material
   - Mainly a green pile

E. Good compost pile (**aerobic**)
   - Have a good mixture of brown-to-green (carbonaceous-to-nitrogenous) material
   - Mix layered material
   - Keep moist
   - Turn regularly

2. Keep a daily record of the temperature of each pile (optional).

3. After three or four weeks, discuss the results. **Ask:** What are the necessary components of a good compost pile? Why does compost pile E break down wastes faster than the others? How do the components of a compost pile work together to decompose material? How is recycling within the compost pile like the nitrogen cycle and other natural cycles in our biosphere? (The nitrogen cycle is the continuous, cyclic progression of chemical reactions in which atmospheric nitrogen is compounded, dissolved in rain, deposited in the soil, assimilated and metabolized by bacteria and plants and returned to the atmosphere by organic decomposition.)
   - Where does composting occur naturally? (In forests and anywhere leaves and organic debris are left alone.)
   - What are the environmental impacts of dumping compostable, organic wastes in landfills? (Decomposing organic material produces **methane gas**, which can be explosive.)
   - Why does composting make sense? (Composting can significantly reduce waste volumes, reduce the production of methane gas and provide a beneficial soil conditioner by recycling natural elements and nutrients.)

## Parts of a Good Compost Pile

- SOIL contains microorganisms that help decomposition.
- ORGANIC MATERIAL – leaves, food scraps and yard trimmings – should be varied to include material with a high-carbon and high-nitrogen content. By alternating these materials, good environmental conditions for decomposition are created.
- NITROGEN is needed by many of the organisms responsible for decomposition. Nitrogen is found naturally in organic waste like manure and grass clippings.
- CARBON is found in brown material like dried leaves, straw and saw dust.
- WORMS eat food scraps and leaves helping to break it down. Worms make droppings that enrich the soil and tunnel through and **aerate** the waste. As the worms eventually die, they become part of the compost.
- WATER is necessary for the normal functioning of life. Too much water in a compost pile may make it soggy and slow to decompose.
- AIR is necessary for the biological activity of fungi, bacteria, small insects and organisms resulting in decomposition. Most biological processes require oxygen.
- TIME is required for material to decompose. To speed decomposition, aerate your compost pile every few days.

- HEAT is produced by chemical reactions resulting from increased biological activity that occurs during decomposition. Heat helps sanitize compost by killing certain organisms such as weed seeds and harmful insect larvae.

- MASS – at least 1 cubic meter of organic material – is needed to generate enough heat for optimal decomposition in the pile. The temperatures reached in a small pile are different than those in a larger one.

## Composting with Worms

You also can use worms for composting. Using this approach, students can discover a beneficial, low technology way to reduce food scraps and yard trimmings; understand the natural process of biodegradation and soil production; see how to improve soil through worm composting; and learn the benefits of composting.

When you compost with worms, it's called **vermicomposting**. Red worms (Eisenia foetida) in worm bins are used to process food scraps into high quality garden compost. Properly constructed and maintained, worm bins do not have an offensive odor. For more information on earthworms, call DHEC at **1-800-768-7348** for the booklet, "Home Composting Made Easy."

Worm bins are beneficial. They help to:

- reduce food scraps and yard trimmings;
- save garbage disposal costs;
- produce an excellent soil amendment; and
- demonstrate the natural processes of biodegradation and the generation of **humus** (soil).

## Making a Worm Bin

You will need the following material to make a composting worm bin.

- Wooden box (24 x 42 x 16 inches), polystyrene ice chest or metal container in which you can drill holes

- Paper (shredded or torn)

- Water

- Red worms (Eisenia foetida) – not earthworms

- Calcium carbonate (egg shells)

- Food scraps (no meat or dairy products)

To set up your worm bin, use the following step-by-step instructions.

1. Select your container. You can use wood, plastic or metal containers as long as they have a lid and are not filled deeper than 12 inches. Several holes should be drilled into the bottom and top of the box to provide air for the worms. A cookie sheet or plastic layer should be placed under the box to catch any debris or water falling through the holes.

2. Discuss with the class the impact of food scraps on the solid waste stream and alternative methods of handling food scraps. Introduce the idea of using red worms.

3. You will need 1 pound of red worms (not earthworms) for the bin. You can purchase red worms from a commercial grower or a bait shop. Look in the telephone book's Yellow Pages under agricultural supplies or search the Internet for vermicomposting supplies.

4. Set up your worm bin. You will need one box filled no deeper than 12 inches (to prevent anaerobic conditions from developing) in a room or space with a temperature between $55^0$F and $77^0$F. You will need twice as many worms as the average daily amount of food scraps. If you generate a half pound of scraps, you will need 1 pound of red worms.

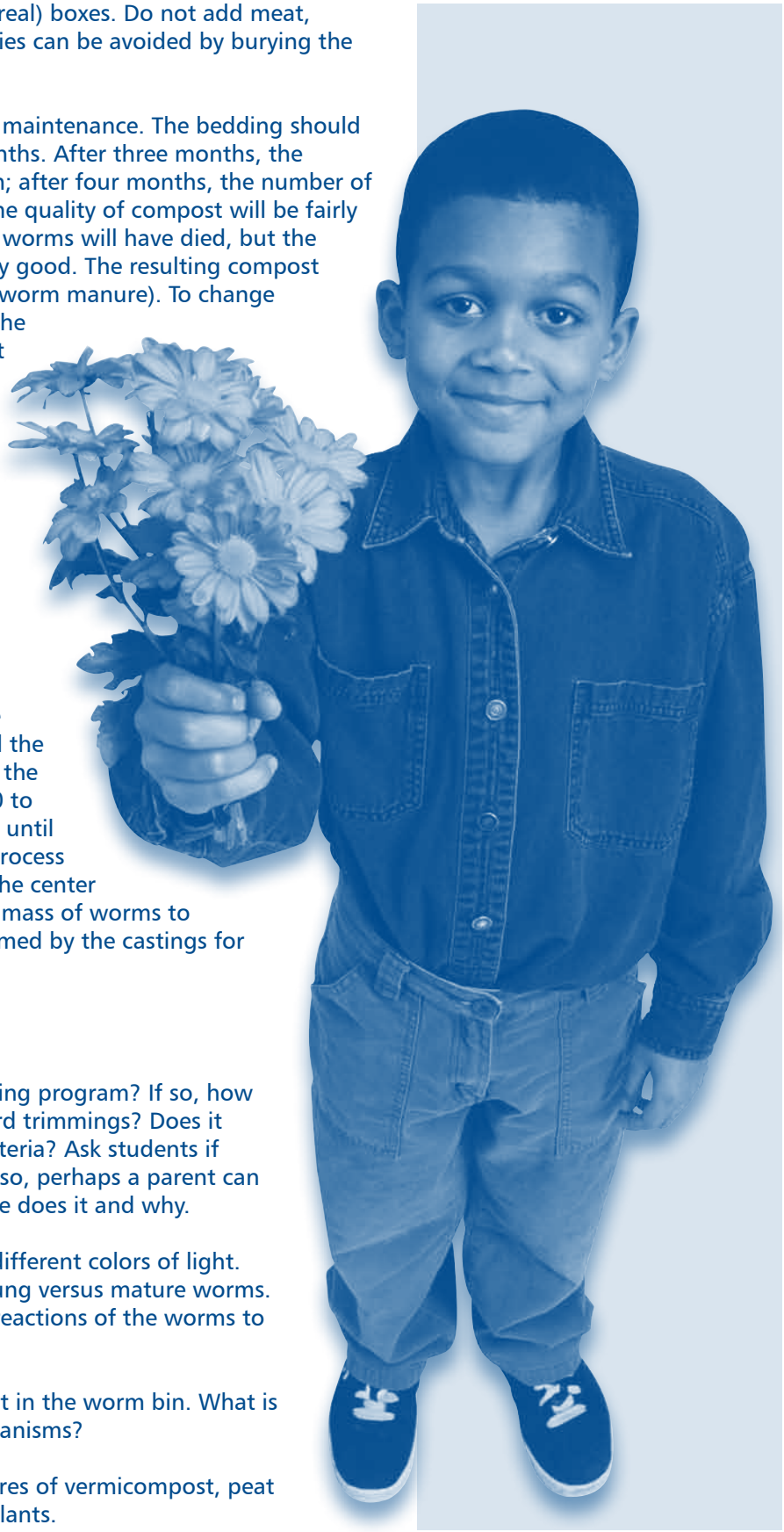
5. Shred the paper by tearing it into strips about 2 inches wide or running it through a shredder. Put the paper in a bucket and slowly add water while fluffing the paper occasionally. Squeeze the paper until it is damp but not dripping. Put the strips of paper in the worm box and sprinkle in several crushed eggshells (for worm reproduction).

6. Gently place the worms in the box, leaving the top open until the worms burrow into the bedding. Close the lid or cover with a black plastic sheet. Bury food in the box each week, rotating the burial location. Some of the foods that will work well in the worm bin are bread, egg shells (a good source of calcium carbonate), leaves, fruit and vegetable peelings, coffee

grounds and torn paperboard (cereal) boxes. Do not add meat, cheese or other oily foods. Fruit flies can be avoided by burying the food scraps.

7. The worm bin needs little routine maintenance. The bedding should be changed every three to six months. After three months, the number of red worms will be high; after four months, the number of red worms will still be high and the quality of compost will be fairly good; after six months, many red worms will have died, but the quality of the compost will be very good. The resulting compost will be primarily **worm castings** (worm manure). To change the worm bedding, either dump the contents of the bin under a bright light and brush the layers of the compost away (the worms will move away from the light and gather at the bottom of the pile) or pull the compost and worms to one side of the bin and add new bedding to the vacant side. Then begin burying food on the new side.

8. Give the worms one month to migrate to the new side. Remove the worm castings and repeat the process. To be certain you have all the worms from the first side, expose the worms to bright light and wait 20 to 30 minutes. Remove the top layer until worms are exposed. Repeat this process until the worms are in a mass in the center of the old bedding. Then add the mass of worms to the new bedding. Use the soil formed by the castings for potted plants or in a garden.



## Extension Activities

1. Does your school have a composting program? If so, how does it work? Does it focus on yard trimmings? Does it include food scraps from the cafeteria? Ask students if any of them compost at home. If so, perhaps a parent can present to the class on how he/she does it and why.

2. Study the reactions of worms to different colors of light. Study the food preferences of young versus mature worms. Using four worm bins, study the reactions of the worms to the four food groups.

3. Study the other organisms present in the worm bin. What is the inter-relationship of these organisms?

4. Study the effects of various mixtures of vermicompost, peat moss, soil and perlite on potted plants.

## Don't burn. Compost.

Why not burn leaves and other yard trimmings? Burning leaves and other yard trimmings pollutes the air and can lead to uncontrolled fires. The smoke also may make breathing difficult for people who suffer from asthma, emphysema, chronic bronchitis or allergies.

## Food for Thought...

South Carolina and most other states, in order to encourage recycling and save landfill space, does not allow grass clippings and other yard trimmings to be disposed of in Class 3 landfills. The intent of the law is to encourage local governments to set up large-scale **mulch** and composting operations.

Unfortunately, in many counties that has not happened and the yard trimmings are disposed of at a different type of landfill. There are counties, however, that divert yard trimmings to grinding facilities that use the end product beneficially in landscaping and other similar applications.

## Resources

- DHEC's Office of Solid Waste Reduction and Recycling Web Site – **www.scdhec.gov/environment/lwm/recycle/compost.htm**
- "Worms Eat My Garbage" by Mary Appelhof
- "Worms Eat Our Garbage" by Mary Appelhof

## Questions for the Class

1. What is composting? (Composting is the natural decomposition of organic material (from plants and animals) such as leaves, yard trimmings, clippings and manure as well as fruit and vegetable scraps.)
2. What are the necessary ingredients for a good compost pile? (Green and brown material as well as air and water)
3. How can composting reduce waste? (It removes food scraps and yard trimmings from household garbage.)
4. What kind of worms are suitable for vermicomposting? (Red worms – Eisenia foetida)
5. What are worm castings? (Worm manure)

# CRAYON TRASH STASH

**PREPARATION TIME:** **EASY-TO-DO**

## Learning Objectives

Students will:

- look at ways resources are wasted; and
- consider options to trashing their used, broken, worn out and unwanted items.

## Background

**Recycling** and composting are important ways to reduce the amount of waste each of us makes, but the most practical, common sense way to reduce waste is to prevent it in the first place. One way to prevent or reduce waste is **reuse**.

Reuse is just one part of waste prevention, also known as **source reduction**, which is the practice of designing, manufacturing, buying and using materials (such as products and packaging) in ways that reduce the amount of waste generated.

There are many ways each of us can reduce waste through reuse. Donate items. Buy remanufactured or used items. Reuse bags, containers and other similar items. Borrow, rent or share items that are used infrequently. Maintain or repair items if possible. Reuse means that waste does not have to be collected and managed and reduces the need to build **landfills** and incinerators. Reuse conserves natural resources. Reuse reduces the impacts of extracting raw materials and manufacturing. Reuse saves money.

## Learning Procedure

1. Distribute a handful of crayons to each student. Some crayons should be new and some should be used, worn and broken. Ask the students to sort their crayons into two piles – new and broken/used.

2. Ask them to describe their worst crayon. List responses on the board. Tell them that their used, worn and broken crayons are "trash," and they are to stash their **trash** in the landfill (inside their desks or into a sack).

3. Using only the new crayons, students are to draw a rainbow. Do not let students share crayons.

4. Display the rainbow pictures. What problems occurred because of the limited **resources**? **Ask:** Do you wish you had more colors?

*Continued on the following page*

## Learning Essentials

**Focus:** Reuse

**Subject:** Science

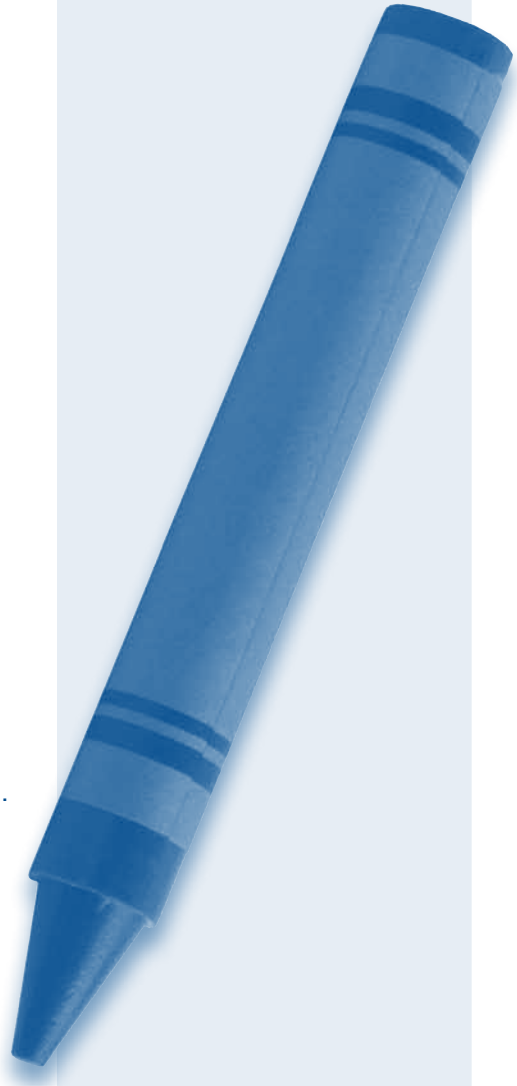
**Extension:** Art

**Materials:** Student's crayons or a large box of used crayons

**Teaching Time:** 30-45 minutes

**Vocabulary:** Landfills, recycling, reuse, resources, source reduction, trash

**Lesson Resources:** "Recycling 101"



Do you wish you had not thrown away the used, worn and broken colors? Do we sometimes throw other things away that we think are used, worn or broken? Name some and record a list on the board. Why do we throw things away? Make a list of reasons. Look again at their words that described the used, worn or broken crayons. Are these some of the same words we use to describe the items that we throw away?

5. Explain that once something is thrown away and taken to the landfill, it almost always stays there forever, but in this case, you will have the rare privilege of reclaiming the crayons from the landfill. Let students add to their pictures. Once this is done, the students will be given the opportunity to rethink how these crayons can be reused or recycled. Some ideas are to make sun catchers, crayon candles or "new" crayons.

## Extension Activities

1. Plan a "Trash to Treasure Fair" for the class. Suggested categories for entries – an item recycled, an item repaired and an item reused. The rainbow pictures can be turned into advertising posters and awards can be made from throw-away materials. A visit to a thrift or second-hand store would be helpful.

2. Make "sun catchers." You will need used crayons, a medium hand kitchen grater, wax paper, irons, pad of newspapers and a brown paper bag. Ask for extra adult volunteers on this day. Perhaps they could bring their own irons.

   A. Have students sort the crayons by color and remove the paper from the crayons.
   B. Ask an adult volunteer to grate the crayons. Crayon shaving also can be done using scissors.

   Complete Steps A and B before you teach the lesson.

   C. Students will sprinkle crayon shavings on a sheet of wax paper, keeping colors separate.
   D. Cover with a second sheet of wax paper, making a sandwich.
   E. Prepare a pad of newspaper to protect surface from iron.
   F. Cut open a brown paper bag and lay on top of newspaper for a blotter.
   G. Put the wax paper sandwich on brown paper and newspaper pad.
   H. Cover sandwich with another piece of brown paper.
   I. Using a medium hot iron, melt the two layers of wax paper together. This also will melt the crayons, creating a stained glass effect.
   J. After cooling, cut the sun catcher into a shape (butterfly, fish, flower, etc.) either by tracing a shape first or by cutting freehand. A mobile of many shapes can be made or they may be hung in a window.

3. Make a "crayon candle." You will need candle wax, used crayons, candle wicks, a pencil, a glass baby food jar, steel (soup) cans with the lids and labels removed, pot holder and an electric frying pan.

   A. Clean and dry baby food jars.
   B. Using a four-inch piece of candle wick, tie the wick in the middle of a pencil. Rest the pencil across the jar opening with the candle wick hanging inside the jar.
   C. Students are to remove paper from crayons and sort by colors into steel cans. Add candle wax to each color to fill the can one-half full.
   D. Pour water into the electric frying pan.
   E. Set cans in the electric frying pan on low to medium heat. When melted, pour a 1/2- to 3/4-inch layer of color in each jar.
   F. Let cool until set enough so that a layer of another color can be poured on top. Layer the colors until the jar is full.
   G. After candle is completely cooled, students can trim candle wick to 1/4- to 1/2-inch.
   H. Make a label saying this gift was made from reused glass and recycled crayons and tie it around the candle.

4. Make "new" crayons. You will need used crayons, five to eight steel (soup) cans with the lids and labels removed, Popsicle sticks, an electric frying pan, water pitcher, pot holders and candy molds.

   A. Have students sort the crayons by color (or mix to make new colors – e.g., blue and yellow make green) and remove the paper from the crayons.

   Complete Step A before you teach the lesson.

   B. Pour water into the electric frying pan.
   C. Place the steel cans in the electric frying pan.
   D. Break the crayons into small pieces and place into the steel cans so they will begin to melt.
   E. Once melted, carefully remove the steel can from the electric frying pan and pour the liquid crayon wax into the candy mold.

   Allow the wax to "cool" (harden). Pop the "new" crayons out of the mold. Place the molds in the refrigerator to speed up the cooling process.

# ENVIRONMENTAL SHOPPING

**PREPARATION TIME: MODERATE**

## Learning Objectives

Students will:

- see how careful buying is the first step in reducing the amount of waste we generate;
- understand how recycled materials are used in packaging;
- determine which natural resources are used in packaging; and
- see how these resources can be conserved through careful buying and recycling.

## Background

Everything each of us buys affects the environment, but some choices are better than others. **Environmental shopping** means buying smart – that is buying products that help conserve natural resources, save energy, prevent waste and maybe even save money. Environmental shopping also can mean not buying things – things that you don't need.

Think before buying. Buy durable instead of disposable products such as rechargeable batteries and reusable cups for drinks. Buy used. Buying things that have been used means that your purchase doesn't use more resources or energy. Look around for used books, CDs, sports equipment and other stuff. Check out thrift stores.

Buy energy efficient – look for the "Energy Star" logo when buying appliances, computers, televisions and other electronics. Buy in bulk. Buy large, single containers of laundry detergent, for example, instead of the same amount in multiple, smaller containers. That not only uses less **packaging** but saves money and reduces the number of times you have to go to the store. Buy recycled. Look for products made from **recycled content** materials. Many kinds of paper products including notebook paper, tissue paper and paper towels are made from recycled paper.

Product packaging presents significant challenges to environmental shopping.

*Continued on the following page*

## Learning Essentials

**Focus:** Environmentally friendly purchasing, resource conservation, consumer awareness

**Subject:** Science

**Extensions:** Home Economics, Math, Social Studies

**Materials:** Student worksheets (included)

**Teaching Time:** 45 minutes including time to conduct surveys

**Vocabulary:** Buy recycled, consumer, environmental impact, environmental shopping, nonrenewable resources, organic, packaging, post-consumer, pre-consumer, recycled content, recycling center, renewable resources

**Lesson Resources:** "Buy Recycled ... and Beyond," "Recycling 101"

Packaging is necessary to contain, protect and dispense materials and products. Packaging preserves freshness and safeguards against contamination, tampering and/or theft. But many products are over-packaged. Consider this: packaging accounts for nearly one-third of all of the waste generated nationwide according to the U.S. Environmental Protection Agency.

It is important when buying to make choices that support responsible products and packaging. When possible, buy products and packaging that can be recycled in your community and/or are made from recycled content materials.

It is easier than you think. No matter where you live, where you shop or what you buy, you have access to recycled content products and packaging. Every time you go to the grocery store, you probably are buying products in packaging that are made entirely or at least partially of recycled-content materials.

Almost all cereal, cracker and cake mix boxes are made of 100 percent recycled paperboard. For paperboard boxes (such as cereal boxes), the rule of thumb is: if the unprinted side is gray, it's made from recycled material. Most cereal boxes have the "100% Recycled Paperboard" logo on them. Steel cans (food and soup) and glass bottles also are made from high percentages of recycled materials. Pass up polystyrene (Styrofoam) egg cartons and choose cardboard instead, which are made from recycled newsprint.

Here are two words you may see when looking for recycled content products and packaging. **Pre-consumer** content refers to waste generated during the manufacturing process that is recovered and placed back into the process (trimmings and overruns, for example). It is waste generated before it reaches the **consumer**. **Post-consumer** refers to the material used by the consumer and has been recycled.

Read the label. Look for specific information on recycled content. If the information is not there or is unclear, call the manufacturer's toll-free number (usually provided on the label) and ask.

## Learning Procedure

1. **Ask:** How can you reduce the amount of packaging you throw away? Encourage students to explain their ideas.

2. Have the students analyze products and packaging using the surveys provided with this lesson. The surveys can be completed by the students individually or by dividing the class into small groups. To complete the surveys, students must understand the following terms.

   - **Organic** – derived from living organisms.

   - **Renewable resources** – natural resources derived from an endless or cyclical source (e.g., sun, wind, trees, fish); with proper

management and wise use, replacement of these resources can be approximately equal to their consumption.

- **Nonrenewable resources** – natural resources that, because of their scarcity, the length of time required to form them or their rapid depletion, are considered finite in amount; examples include oil, coal, natural gas and copper.

3. Give one copy of "Survey 1: Products & Packaging" to each student or group of students.

4. Have them choose five products and complete the survey for each one. Have students choose a variety of products that come in a variety of packaging.

**FOLLOW-UP QUESTIONS FOR "SURVEY 1: PRODUCTS & PACKAGING"**

- Which products need special packaging to protect human health?
- Which packages were made from recycled materials?
- Which products can be bought in bulk or in large containers?
- Which products can be bought in a less processed or packaged form?
- Which packaging can be improved to save energy and natural resources as well as reduce waste?

5. Distribute copies of "Survey 2: A Potato By Any Other Name." As a homework assignment, have students find a variety of potato products (fresh, frozen, boxed, canned, bagged and prepared – like fast-food french fries) and complete the survey.

**FOLLOW-UP QUESTIONS FOR "SURVEY 2: A POTATO BY ANY OTHER NAME"**

- What affect did processing and packaging have on a product's cost?
- How did the package's size affect the cost?
- What affect did package size have on the amount of waste?
- What else was added to food as it became more highly processed?
- List examples of recyclable packaging.
- List the products that were not available in recyclable packaging.
- List examples of packaging made from recycled materials.
- List some ways that people can reduce waste and increase recycling with careful shopping.

## Extension Activities

1. Have each student bring samples of recyclable and reusable packaging from home. Using the samples, have the class create a guide to recyclable packaging in your community. Have students publish their packaging guide in the school newspaper. Have students illustrate packaging that can be recycled and list local **recycling centers** and programs that collect the material. For a list of materials collected in your community, call **1-800-768-7348** or visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE.

2. Green Seal is an independent, non-profit organization dedicated to safeguarding the environment and transforming the marketplace by promoting the manufacture, purchase and use of environmentally responsible products and services. The Green Seal is awarded to products that have less impact on the environment and work well. The Green Seal may be used on packaging, promotional material, catalogs and in advertising for products that have been certified. The Seal provides a business advantage, for it identifies a product as environmentally preferable, provides third-party corroboration of environmental claims and distinguishes a product from competitors that can't support their environmental assertions. The Green Seal may be used on packaging, in promotional material, in catalogs and in advertising for products that have been certified to meet the applicable standard. For more information about Green Seal, visit **www.greenseal.org**. Have students research and find products that have the Green Seal.

3. Buy and use rechargeable batteries. The Rechargeable Battery Recycling Corporation (RBRC) is a non-profit, public service organization dedicated to recycling Nickel-cadmium (Ni-Cd), Nickel Metal Hydride (Ni-MH), Lithium Ion (Li-ion) and Small Sealed Lead (Pb) rechargeable batteries as well as cell phones. These batteries power many portable products such as cellular and cordless phones, power tools, lap-top computers, camcorders, MP3 players, digital cameras and remote-controlled toys. Consumers can recycle their rechargeable batteries at more than 50,000 retail stores across the country. For the location of a collection site near you, call **1-800-8-BATTERY** or visit **www.rbrc.org**. Find out how many retailers participate in this recycling program in your community.

4. The Product Stewardship Institute (PSI) is a national non-profit membership-based organization that works with state and local government agencies to partner with manufacturers, retailers, environmental groups, federal agencies and other key stakeholders to reduce the health and **environmental impacts** of consumer products. PSI takes a unique product stewardship approach to solving waste management problems by encouraging product design changes and mediating stakeholder dialogues. Visit **www.productstewardship.us** to find out what products or issues PSI is addressing.

## Watch the Words

Beware of the word "recyclable," which is not the same as "recycled." Many products are recyclable, but what matters is what you can recycle in your local program.

When shopping, look for the chasing arrows on the products you buy. Below are three common recycling symbols found on packaging. The first symbol simply means the product or package can be recycled. The second means 100 percent of the product or package is made from recycled materials. The third means the product or package is made from both recycled and virgin materials.

**RECYCLABLE**

**100 PERCENT RECYCLED**

**LESS THAN 100 PERCENT RECYCLED**

**Student Worksheet**

Name: _____

## SURVEY 1:

# PRODUCTS & PACKAGING

| PRODUCT | RENEWABLE RESOURCE | | NON-RENEWABLE RESOURCE | | Is the product necessary? | Is it available in more than one form of packaging? | Which packaging is best in terms of recycling and waste reduction? | Is there an alternative to this product? | How could the packaging be improved to save energy and resources? | What happens to the packaging when the contents are used? |
|---|---|---|---|---|---|---|---|---|---|---|
| | Recyclable | Non-recyclable | Recyclable | Non-recyclable | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

**Student Worksheet**

Name: _____

## SURVEY 2:

# A POTATO BY ANY OTHER NAME

| PRODUCT | RECYCLABLE PACKAGE? | PACKAGE WEIGHT | PRICE | PRICE PER POUND |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# GARBAGE SNOOPING

**PREPARATION TIME: MODERATE**

## Learning Objectives

Students will:

- define waste and consider the implications of throwing something away;
- analyze their family's waste stream; and
- discuss ways of reducing waste.

## Background

Each of us produces **solid waste** – better known as **garbage** or **trash**. There are different kinds of solid waste, but the type discussed in this lesson is **municipal solid waste** (MSW). This kind of waste comes from homes, but it also comes from some businesses, organizations and schools. MSW includes paper, cans, bottles, food scraps, yard trimmings and packaging.

MSW is managed generally one of two ways: it is disposed of in a Class 3 **landfill**; or it is **recycled/composted**.

In South Carolina, county governments are required by law to report to the S.C. Department of Health and Environmental Control (DHEC) the amount of MSW recycled. In addition, permitted solid waste facilities are required to report each year to DHEC the amount of MSW disposed of at their facilities.

The amount of MSW disposed of is provided only as a total – and not by individual commodities (such as paper, bottles, cans, etc). Conversely, the amount of MSW recycled is reported as a total and by commodity.

South Carolina also has a goal to recycle at least 40 percent of the MSW generated in the state and a goal to dispose of (in a Class 3 landfill) no more than 3.25 pounds of MSW per person per day.

Each of us, each day, makes about 5.0 pounds of MSW in South Carolina. Of that amount, about 3.6 pounds is disposed of in Class 3 landfills and about 1.4 pounds is recycled.

*Continued on the following page*

## Learning Essentials

**Focus:** Household waste stream

**Subject:** Science

**Extensions:** Language Arts, Social Studies

**Materials:** "Note to Parents," Garbage Detective Badges, "Garbage Container Survey," "Recycle Bin Survey"

**Teaching Time:** 60 minutes, excluding home garbage and recycle bin studies

**Vocabulary:** Composted, disposal, garbage, incinerator, landfill, municipal solid waste, recycled, solid waste, trash, waste stream

**Lesson Resources:** "Garbage 101," "Landfill 101"

Individual county numbers are available at **www.scdhec.gov/recycle**. (Click on SOLID WASTE ANNUAL REPORTS and then click on the S.C. Solid Waste Management Annual Report.)

## Learning Procedure

1. Give students the background on the amount of garbage or trash (defined as MSW) that is generated in the state both overall and individually. Explain that the state receives reports on the amount of MSW disposed of in Class 3 landfills and the amount of MSW recycled. It is important to remember that only the total amount of MSW disposed is measured.

2. Give each student an official Garbage Detective Badge (included). Their assignment: determine what items are in their garbage at home.

3. Have the students make assumptions about the average household's garbage. What does the typical bag of garbage contain? Make a list. In what proportion are these items found? Consider the following materials: plastic; glass; newspaper; steel cans; cardboard; aluminum; and other items.

4. Now it's time for the investigation. Each detective will keep a record of his/her household garbage for one week. The students should follow the procedure outlined below:

   - Explain the investigation assignment to family members and ask for their cooperation. See "Note to Parents" included with this lesson. Ask family members to put all their garbage in pre-determined collection areas to help make the job easier. For health reasons, do not include food scraps or yard trimmings in the items collected.
   - At the end of each day, empty the contents of the garbage and recycling containers onto a large plastic sheet in the garage or yard.
   - Wear gloves to separate the garbage and recyclables into categories – plastic, glass, newspaper, steel cans, cardboard, aluminum and other items. Then count and/or weigh – if a scale is available – each category. Keep a record on the chart provided. Take special care when handling cans, glass, etc.
   - Use the separate chart provided and repeat the process for the items that can be recycled.
   - Be sure to return all garbage and recyclables to appropriate containers.

5. After a week, have the students write a summary of their research and present their findings to the class.

## Questions for the Class

1. What did your family throw away?

2. Were you surprised at the amount that was thrown away? Explain.

3. How did your findings compare to others in the class?

4. Were items thrown away that could have been reused or recycled?

5. Were you surprised by the number of items that could be recycled.

## Extension Activities

1. The records of family garbage kept by students can be used as an evaluation tool. Have students suggest one action that can be taken to reduce the family's **waste stream**. Then, practice this action and repeat the investigation after a month to see if students have reduced their family's waste stream.

2. Have the class produce a large chart indicating what they found during their garbage snooping.

3. All living creatures produce some sort of waste but their ways of disposing of it vary greatly. Humans are very wasteful compared to other creatures on Earth. Often we are unconcerned with what happens to our waste and unaware of the impacts it can have on the environment. By looking at how animals and plants minimize the amount of waste they produce as well as the ways in which they deal with their garbage we can learn some important lessons about efficiency and waste **disposal**.

   - Have the students research an animal of their choice to learn about its habitat, way of living, the kinds and amount of waste it produces and its methods of dealing with this waste. The students could write and illustrate stories based on what they have learned and present them to the class.

   - Ask each student to draw two pictures: one of their house and the other of an "animal's house." Have the students share their pictures with the class and start a discussion on where garbage fits into each picture. **Ask:** Do animals make garbage? Who produces more garbage – people or animals? What are some differences and similarities between waste generated by people and animals? Why do people throw away so much more than animals? How do people get rid of their garbage? Where does it go? What could people do to be more like animals regarding the production and disposal of waste?

## Note to Parents

Our class is participating in a school project about the impact of throwing something away. We will learn how to recycle and reuse materials and reduce the waste that is thrown away. For this project, your child will determine what your family throws away and will consider ways to reduce the amount of garbage you produce.

Please help your child be a Garbage Detective. Your child has been given the following instructions for performing this activity:

1. Ask family members to put all their garbage and recyclables in pre-determined collection areas to help make the job easier. For health reasons, do not include food scraps or yard trimmings in the items collected.
2. At the end of each day, empty the contents of the containers onto a large sheet of plastic in the garage or yard.
3. Wear gloves to separate the garbage and recyclables into categories: plastic; glass; newspaper; steel cans; cardboard; aluminum; and other. Then count and/or weigh – if a scale is available – each category. Keep a record on the chart provided. Take special care when handling cans, glass, etc. Keep a separate chart for the items you recycle.
4. Be sure to return all garbage and recyclable items to appropriate containers.

After a week, the detectives will write a summary of their research and present their findings to the class. Recycling some of what we otherwise throw away is an easy habit to form. By finding out what materials can be recycled in our community and changing some buying habits, your family can help reduce waste in South Carolina. We hope you will encourage your child by making this a family project. Thanks for reducing, reusing and recycling.

## Garbage Detective Badges

# Here's what I found snooping in the GARBAGE CONTAINER.

| Day of the Week | Plastic | Glass | Newspaper | Steel Cans | Cardboard | Aluminum | Other |
|---|---|---|---|---|---|---|---|
| MONDAY | | | | | | | |
| TUESDAY | | | | | | | |
| WEDNESDAY | | | | | | | |
| THURSDAY | | | | | | | |
| FRIDAY | | | | | | | |
| SATURDAY | | | | | | | |
| SUNDAY | | | | | | | |
| WEEKLY TOTAL FOR EACH ITEM COLLECTED | | | | | | | |

# Here's what I found snooping in the RECYCLING BIN.

| Day of the Week | Plastic | Glass | Newspaper | Steel Cans | Cardboard | Aluminum | Other |
|---|---|---|---|---|---|---|---|
| MONDAY | | | | | | | |
| TUESDAY | | | | | | | |
| WEDNESDAY | | | | | | | |
| THURSDAY | | | | | | | |
| FRIDAY | | | | | | | |
| SATURDAY | | | | | | | |
| SUNDAY | | | | | | | |
| WEEKLY TOTAL FOR EACH ITEM COLLECTED | | | | | | | |

# HAZARDOUS HOUSEHOLD WASTE

| PREPARATION TIME: | EXTENSIVE |
|---|---|

## Learning Objectives

Students will:

- define hazardous household materials and products;
- develop an awareness of the potential hazards of common household products; and
- identify places they may be found.

## Background

Unwanted or leftover household products that contain **flammable**, **toxic**, **corrosive** or **reactive/explosive** ingredients are considered to be **hazardous household waste** (HHW).

Examples of products that could become HHW include lawn and garden care products, paint, automotive fluids and batteries, beauty products, medicine and household cleaners. An average home has about 100 pounds of hazardous products stored throughout the house from under the sink to the garage and untold places in between, according to the U.S. Environmental Protection Agency.

Products are considered hazardous if they have at least one of the following characteristics:

- FLAMMABLE: Products that can easily be set on fire such as gasoline, oil-based paint, paint thinners, aerosol spray products and degreasers;
- TOXIC: Products that are capable of causing injury or death through swallowing, inhalation or skin absorption such as pesticides and antifreeze;
- CORROSIVE: Products that may have a chemical reaction that can burn you or destroy other materials when brought in contact with each other – such as oven cleaners, swimming pool chemicals, toilet bowl cleaners, battery acid and ammonia;
- EXPLOSIVE/REACTIVE: Products that can explode through exposure to heat, pressure or other substances such as ammunition and road flares.

These household products must be used, stored and disposed of properly to protect people, pets and the environment. Always read the product label carefully.

*Continued on the following page*

## Learning Essentials

**Focus:** Hazardous household products

**Subject:** Science

**Extensions:** Language Arts, Social Studies

**Materials:** Samples of hazardous household products, "What's in Your House" Student Worksheet, "Common Hazardous Household Products" Student Worksheet and Teacher's Answer Key, "Home Safe Home" Student Handout

**Teaching Time:** Two class periods

**Vocabulary:** Caution, corrosive, danger, explosive, flammable, hazardous household products, poison, reactive, signal words, toxic, warning

**Lesson Resources:** "Hazardous Household Products"

HHW is not your typical household waste. If poured down drains or toilets, HHW can contaminate septic tanks and wastewater treatment plants. If poured on the ground or down storm drains, HHW can harm rivers, lakes and streams. Flammable or toxic HHW mixed with your household garbage can release toxic fumes, explode or catch fire and hurt family members or sanitation workers.

The best way to reduce the amount of HHW is to use the entire product and, if you can't, share it with someone else. If that is not possible, find out if your community has a HHW collection program or offers single-day collection events. For more information, call **1-800-768-7348**.

## Learning Procedure: Day One

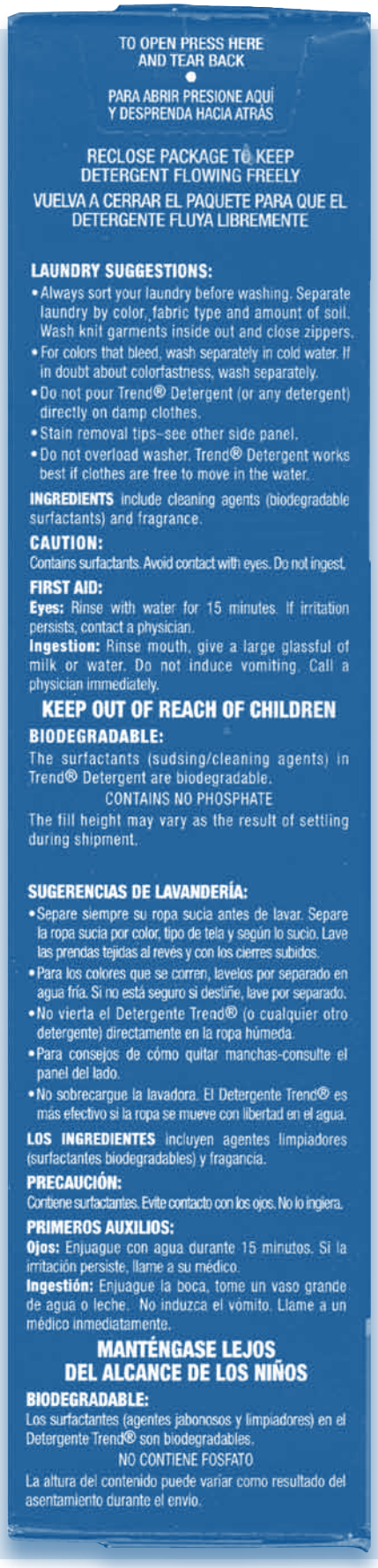
1. Begin discussion by showing students samples of hazardous household products (e.g., bleach, drain opener, furniture oil, paint, medicine, rat poison, fertilizers, moth balls).

2. Tell students to read product labels and look for these **signal words**: **DANGER**; **POISON**; **WARNING**; and **CAUTION**. These federally mandated words indicate the degree of immediate hazard posed by the product. Generally, DANGER or POISON indicates that a product is extremely hazardous because it is poisonous, extremely flammable or corrosive. WARNING or CAUTION indicates products are somewhat less hazardous. Products with no signal words are usually the least hazardous. Write these words on the board. Ask students to define these words. Accept answers and modify so that definitions are correct and easy to comprehend and remember. Have students write the definitions.

3. Write the words HAZARDOUS HOUSEHOLD PRODUCTS on the board. Have students develop a definition and then write it down. Tell the class that many home and garden products are potentially dangerous. Remind student to look for the signal words on the labels – DANGER, POISON, WARNING and CAUTION. Make three columns on the board, labeled: HOUSEHOLD PRODUCT; POTENTIAL HAZARD; and CATEGORY. Ask students to think of some commonly used household products that can be both helpful and potentially hazardous (furniture polish cleans and shines furniture, but might also cause injuries if ingested or sprayed in the eyes). Ask students how they would label the products using the four categories of hazard – DANGER, POISON, WARNING and CAUTION.

4. Distribute the student worksheet "What's in Your House?" and list of potentially hazardous household products. Allow time for students to read. Discuss any products not suggested earlier.

**Sample:**
**DRAIN CLEANER**



TO OPEN PRESS HERE
AND TEAR BACK

PARA ABRIR PRESIONE AQUÍ
Y DESPRENDA HACIA ATRÁS

RECLOSE PACKAGE TO KEEP
DETERGENT FLOWING FREELY

VUELVA A CERRAR EL PAQUETE PARA QUE EL
DETERGENTE FLUYA LIBREMENTE

**LAUNDRY SUGGESTIONS:**

- Always sort your laundry before washing. Separate laundry by color, fabric type and amount of soil. Wash knit garments inside out and close zippers.
- For colors that bleed, wash separately in cold water. If in doubt about colorfastness, wash separately.
- Do not pour Trend® Detergent (or any detergent) directly on damp clothes.
- Stain removal tips–see other side panel.
- Do not overload washer. Trend® Detergent works best if clothes are free to move in the water.

**INGREDIENTS** include cleaning agents (biodegradable surfactants) and fragrance.

**CAUTION:**
Contains surfactants. Avoid contact with eyes. Do not ingest.

**FIRST AID:**
**Eyes:** Rinse with water for 15 minutes. If irritation persists, contact a physician.
**Ingestion:** Rinse mouth, give a large glassful of milk or water. Do not induce vomiting. Call a physician immediately.

**KEEP OUT OF REACH OF CHILDREN**

**BIODEGRADABLE:**
The surfactants (sudsing/cleaning agents) in Trend® Detergent are biodegradable.

CONTAINS NO PHOSPHATE

The fill height may vary as the result of settling during shipment.

**SUGERENCIAS DE LAVANDERÍA:**

- Separe siempre su ropa sucia antes de lavar. Separe la ropa sucia por color, tipo de tela y según lo sucio. Lave las prendas tejidas al revés y con los cierres subidos.
- Para los colores que se corren, lavelos por separado en agua fría. Si no está seguro si destiñe, lave por separado.
- No vierta el Detergente Tread® (o cualquier otro detergente) directamente en la ropa húmeda.
- Para consejos de cómo quitar manchas-consulte el panel del lado.
- No sobrecargue la lavadora. El Detergente Trend® es más efectivo si la ropa se mueve con libertad en el agua.

**LOS INGREDIENTES** incluyen agentes limpiadores (surfactantes biodegradables) y fragancia.

**PRECAUCIÓN:**
Contiene surfactantes. Evite contacto con los ojos. No lo ingiera.

**PRIMEROS AUXILIOS:**
**Ojos:** Enjuague con agua durante 15 minutos. Si la irritación persiste, llame a su médico.
**Ingestión:** Enjuague la boca, tome un vaso grande de agua o leche. No induzca el vómito. Llame a un médico inmediatamente.

**MANTÉNGASE LEJOS
DEL ALCANCE DE LOS NIÑOS**

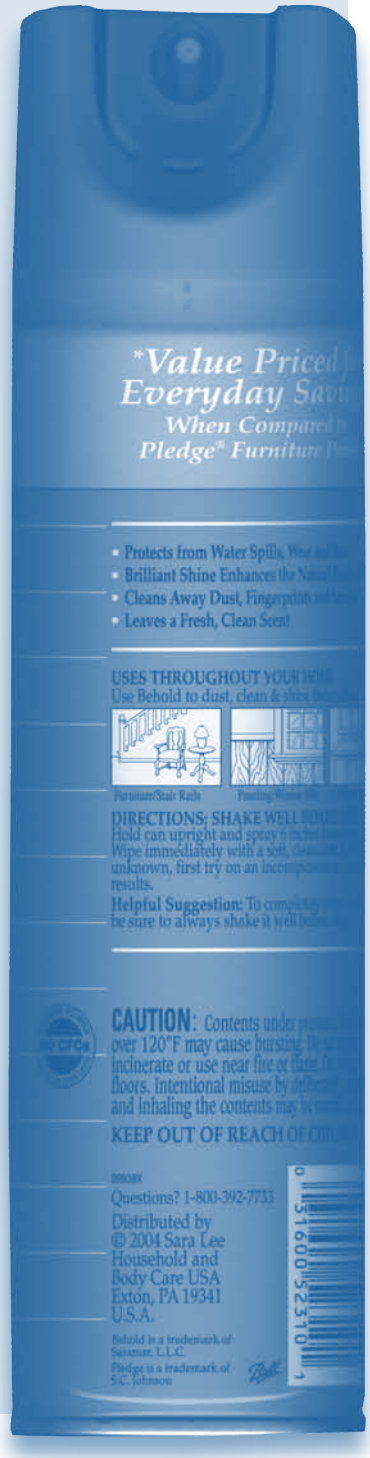
**BIODEGRADABLE:**
Los surfactantes (agentes jabonosos y limpiadores) en el Detergente Trend® son biodegradables.

NO CONTIENE FOSFATO

La altura del contenido puede variar como resultado del asentamiento durante el envío.

**Sample:
LAUNDRY
DETERGENT**

**Sample:
FURNITURE
POLISH**




5. Have the class develop a pictorial legend for each of the four categories of hazardous household products/materials. (e.g., CAUTION could be a diamond with a C in the middle, WARNING a circle with a W in the middle, DANGER a rectangle with a D in the middle, and POISON a square with a P in the middle. Keep them simple and have the class agree on one set of symbols.) Have students draw the appropriate legend for each category shown in the box provided on the "What's in Your House?" Student Worksheet.

6. Discuss where various hazardous household products may be found in their homes. Discuss how the amount of hazardous household products used in every house varies. Discuss the different ways that people use and store hazardous household products in their homes.

7. Tell students that many accidents in the home can be avoided if products are kept out of reach of children. Ask students to give some examples of how products can be kept out of reach (high shelf out of climbing range, locked cupboard, secure drawer).

8. Have students survey their homes for hazardous household products using the "What's in Your House?" Student Worksheet to list what they found and where. Remind students that these products are dangerous and that this activity should be completed with parental permission and under parental supervision.

## Learning Procedure: Day Two

9. Have students share their findings from the home assignment.
10. Define FLAMMABLE, TOXIC, CORROSIVE and EXPLOSIVE/REACTIVE. Have students complete the "Common Hazardous Household Products" Worksheet.
11. Distribute "Home Safe Home" Student Handout to be taken home.

## Alternatives to Hazardous Household Material

The best way to handle hazardous household material is to avoid them altogether; that is, use less toxic substitutes that will still get the job done. Here are a few alternative suggestions.

- **ALL-PURPOSE CLEANER:** Mix 1/2 cup of borax with one gallon of water.
- **FABRIC SOFTENERS:** Add 1/4 cup of baking soda or white vinegar to the rinse cycle.
- **FURNITURE POLISH:** Mix 2 parts vegetable oil and 1 part lemon juice.
- **SILVER POLISH:** Soak silver in 1 quart of warm water with 1 teaspoon of baking soda, 1 teaspoon of salt and a small piece of aluminum foil.
- **CHROME AND STAINLESS STEEL CLEANER:** Dip dry cloth into flour and rub the surface.
- **WOOD FLOOR CLEANER:** Dampen cloth with a solution of water and mild soap. Wring cloth almost dry and wipe section by section, so that no section stays wet.
- **BRASS CLEANER:** Mix equal parts lemon juice and baking soda to make a paste. Cover brass surface with paste and allow to dry, then wipe off quickly.
- **COPPER CLEANER:** Mix equal parts of salt and flour. Heat an equal part of vinegar and add to mixture to create a paste. Rub on copper surface.
- **CERAMIC TILE CLEANER:** Mix equal parts of white vinegar and borax to paste consistency. Rinse and wipe dry.
- **GLASS CLEANER:** Mix 3 tablespoons of white vinegar in 2 cups of warm water.

## Web Resources

Additional Web sites that offer alternatives include:

- Maryland Cooperative Extension, **http://extension.umd.edu/publications/pdfs/hw1.pdf**;
- New York State Department of Environmental Conservation's Division of Solid and Hazardous Materials, **www.dec.ny.gov/docs/materials_minerals_pdf/hhwcht.pdf**; and
- Alameda County, **http://stopwaste.org/home/index.asp?page=585**.

## Questions for the Class

1. What are the four characteristics or properties of hazardous household products?
2. Where should all hazardous household products be stored?

## Extension Activities

1. Have students create a hazardous household products publication that will be made available to the school and community newspapers. The publication should include:
   a. typical hazardous products found in homes and institutions (from the lists they compiled);
   b. the hazardous category of each product and an explanation of the hazard;
   c. recommendations for homemade products or methods to use in the home; and
   d. sources of help and/or information for problems encountered in the use and disposal of hazardous products.
2. Invite your county recycling coordinator or another professional from your local solid waste management department to visit your class and discuss potential environmental risks of common hazardous household products.

## Teacher's Answer Key

# COMMON HAZARDOUS HOUSEHOLD PRODUCTS

Many of the items we use every day can become a problem if they are used, stored or disposed of improperly. Products are considered hazardous – that is, harmful to human health and the environment – if they have one or more of the following properties: **flammable**; **toxic**; **corrosive**; and **explosive/reactive**.

**DIRECTIONS:** Place an **F** if the object is flammable, **T** if it is toxic, **C** if it is corrosive or **E** if it is explosive/reactive. Some items may have more than one letter. One item has no letters.

| | |
|---|---|
| C, T | 1. cell phone battery (rechargeable) |
| C, T | 2. car battery |
| E, F | 3. shaving cream can |
| E, F | 4. gasoline |
| E, F | 5. empty spray paint can |
| C, T | 6. drain cleaner |
| T, E | 7. empty insecticide spray can |
| F, E | 8. unused matches |
| F | 9. used match |
| T | 10. unused drugs and medications |
| F, E, T | 11. unused fertilizer |
| T | 12. broken thermometer (silver-colored only) |
| T | 13. rug spot remover |
| F, T | 14. lacquer |
| T | 15. flea killer collar for pets |
| T | 16. newspaper |
| | 17. paper |
| E | 18. used spray deodorant can |
| C, T | 19. hydrochloric acid from school lab |
| C, T | 20. flashlight battery (non-rechargeable) |

**Student Worksheet**

Name: _____

# WHAT'S IN YOUR HOUSE?

Hazardous household products can be found in many places in the home. Where did you find the following products? Write the location in the line beside the name of the product. Remember, to look for the signal words – DANGER, POISON, WARNING and CAUTION – on the product labels.

## CAUTION

MEDICINES _____

BLEACH _____

FURNITURE POLISH _____

BUBBLE BATH _____

SCOURING POWDER _____

COSMETICS _____

## DANGER

OVEN CLEANERS _____

POOL ACID _____

PAINT THINNER, TURPENTINE _____

CHARCOAL LIGHTER FLUID _____

GUNS AND AMMUNITION _____

## WARNING

LAUNDRY DETERGENT _____

FLOOR POLISH _____

PET FLEA COLLARS _____

DISINFECTANT CLEANERS _____

## POISON

SLUG BAIT _____

TOILET BOWL CLEANERS _____

WEED KILLERS _____

ROACH SPRAY _____

ANTIFREEZE _____

ROOM DEODORIZERS _____

RAT POISON _____

NO-PEST STRIPS _____

GLASS & WINDOW CLEANERS _____

MOTHBALLS _____

DRAIN OPENERS _____

**Student Worksheet** Name: _____

# COMMON HAZARDOUS HOUSEHOLD PRODUCTS

Many of the items we use every day can become a problem if they are used, stored or disposed of improperly. Products are considered hazardous – that is, harmful to human health and the environment – if they have one or more of the following properties: **flammable**; **toxic**; **corrosive**; and **explosive/reactive**.

**DIRECTIONS:** Place an **F** if the object is flammable, **T** if it is toxic, **C** if it is corrosive or **E** if it is explosive/reactive. Some items may have more than one letter. One item has no letters.

_____ 1. cell phone battery (rechargeable)

_____ 2. car battery

_____ 3. shaving cream can

_____ 4. gasoline

_____ 5. empty spray paint can

_____ 6. drain cleaner

_____ 7. empty insecticide spray can

_____ 8. unused matches

_____ 9. used match

_____ 10. unused drugs and medications

_____ 11. unused fertilizer

_____ 12. broken thermometer (silver-colored only)

_____ 13. rug spot remover

_____ 14. lacquer

_____ 15. flea killer collar for pets

_____ 16. newspaper

_____ 17. paper

_____ 18. used spray deodorant can

_____ 19. hydrochloric acid from school lab

_____ 20. flashlight battery (non-rechargeable)

**Student Handout**

# HOME SAFE HOME

Do you or someone else in your home use products like detergents, nail polish remover, gasoline, hair spray, paint and bleach? These products and many more that are commonly found in our homes can be flammable, toxic, corrosive or explosive/reactive. Here are a few guidelines that will help you use hazardous household products safely.

1. **Use a less hazardous product.** For example, use a water-based paint instead of an oil-based paint.

2. **Read labels carefully.** Know what you are buying and how to use the product.

3. **Buy only what you need and use what you buy.** This will eliminate or at least reduce the amount you need to dispose of properly.

4. **Do not mix bleach and ammonia.** Some products may react and become toxic.

5. **Keep labels on the containers.** Keep this important information available on how to use and identify the product.

6. **Keep products in their original containers.** Some chemicals react with plastic materials. Never store chemicals in old food containers.

7. **Do not reuse chemical product containers** Many chemicals leave residue in their containers.

8. **Properly dispose of all hazardous household products.** Some products can contaminate our water resources (including drinking water), our soil and the air we breathe.

9. **Take additional precautions.** Avoid wearing soft contact lenses when using hazardous household products – they can absorb vapors and trap them against the eyes. Wear old clothes – wash separately and dry on the line if possible. Be sure to wash all exposed body parts when you finish using a product. Be sure to clean up before you eat – even if you've used gloves.

10. **Put Mr. Yuk or similar stickers on hazardous household products** and teach children to leave them alone. (Mr. Yuk is used by permission from the Pittsburgh Poison Center.)

# LOOK IN YOUR GARBAGE CAN

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- see what the average family of four throws away every day;
- learn how much Americans throw away and recycle each year; and
- discover what steps can be taken to reduce the amount of garbage a family generates by reusing, recycling and composting.

## Background

Let's talk trash. What did you throw away today? An empty cereal box? Your lunch bag? Some papers from school?

Think about it. You probably will be surprised at the amount.

Here are some numbers to consider. In South Carolina every day, each of us generates about 5.0 pounds of **garbage** – also known as **municipal solid waste** (MSW) – in fiscal year (FY) 2011 (July 1, 2010 to June 30, 2011). MSW is simply defined as solid waste that we make in our homes and schools as well as where we work. That's 1,825 pounds for each of us every year and 7,300 pounds for a family of four.

Overall, South Carolinians generated about 4.2 million tons of MSW in FY 2011. Of that amount, nearly 3.1 million tons were disposed of in Class 3 landfills. The remaining 1,172,768 tons were recycled.

Overall, Americans generated about 250 million tons of MSW in 2010 according to the U.S. Environmental Protection Agency (EPA).

The EPA provides a report every other year on what makes up our waste. The waste characterization study breaks down waste by categories such as paper, yard trimmings, food scraps, plastic, metal, rubber, leather and textiles, wood and glass.

While recycling has been an environmental success story in South Carolina, there's still much to do. Most of what is being thrown away can be recycled or composted.

*Continued on the following page*

## Learning Essentials

**Focus:** Garbage awareness

**Subject:** Science

**Extensions:** Math, Social Studies

**Materials:** Heavy cardboard or construction paper, colored marking pens

**Teaching Time:** One class period

**Vocabulary:** Garbage, grasscycling, municipal solid waste

**Lesson Resources:** "Backyard Composting," "Garbage 101," "Recycling 101"

## Learning Procedure

In this activity, students will examine the amount of waste generated nationally, according to weight.

1. Using heavy cardboard, draw an illustration of a garbage can and cut it out. Then cut it into nine pieces. Each piece should be sized according to one of the nine categories of waste including: paper; food scraps; yard trimmings; plastics; metal; rubber, leather and textiles; wood; glass; and miscellaneous. Then label each piece with the MSW category and the percentage of garbage by weight.

2. **Ask:** What is in your garbage can?

3. Place all nine pieces of your version of the garbage can face down on a table. Divide the students into eight groups and have a student from each group choose a piece. (The teacher should keep the Miscellaneous puzzle piece.) Have the student show and read what is on the card and then tape it on the board. As students select pieces they will assemble the garbage can on the board. In the individual groups, have the students research their selected category of waste. Use the following facts as a guide for each selected garbage category. Some discussion questions are included.

   **PAPER:** About 29.0 percent by weight of everything we generate is paper and paperboard.

   - Paper and paperboard (which includes office paper, newspaper and cardboard boxes) were the No. 1 category of the nation's MSW stream in 2010. Americans generated 71.3 million tons of paper and paperboard before recycling.

   - Paper and paperboard were the top materials recycled by weight in 2010. Nearly 63 percent (44.5 million tons) of paper and paperboard generated were recovered for recycling.

   - About 85 percent of all corrugated cardboard boxes and 71.6 percent of all newspapers, inserts and directories were recycled.

   **Ask:** What are some things that we throw away that are paper? What are some paper products that can be recycled? What products are made from recycled paper? (Examples include legal pads and notebook paper.) What products are packaged in recycled paper and paperboard? (Look on cereal boxes and other products for the recycling symbol or information about recycled content packaging.)

   **FOOD SCRAPS:** About 13.9 percent by weight of everything we generate is food scraps.

   - Food scraps (which include uneaten food and food preparation scraps) were the No. 2 category of the nation's MSW stream in 2010. Americans generated 34.76 million tons of food scraps before recycling.

   - About 2.8 percent (970,000 tons) of food scraps generated were composted.

   **Ask:** Do you compost food scraps at home? Does your school have a composting program for food scraps from its cafeteria? Food scraps that can be composted include fruit and vegetable scraps, coffee grounds and egg shells.

   **YARD TRIMMINGS:** About 13.4 percent by weight of everything we generate is yard trimmings.

   - Yard trimmings (which includes grass, leaves, tree and brush trimmings) were the No. 3 category of the nation's MSW stream in 2010. Americans generated 33.4 million tons of trimmings before recycling.

   - About 57.5 percent (19.2 million tons) of yard trimmings generated were recovered for recycling.

   **Ask:** Do you compost at home? Does your school have a composting program. Introduce the term **grasscycling** (leaving grass clippings on the lawn when cutting the grass).

**PLASTICS:** About 12.4 percent by weight of everything we generate is plastic.

- Plastics (which include soft drink and water bottles, milk jugs and many other products and applications) were the No. 4 category of the nation's MSW stream in 2010. Americans generated 31.04 million tons of plastic before recycling.

- About 8.2 percent of plastics (2.55 million tons) were recycled. While overall recovery of plastics for recycling is small, the recovery of some plastic containers is more significant. About 29 percent of PET bottles and 28 percent of HDPE bottles were recycled.

  **Ask:** What are some things that are made from plastic? (Many of the things we use each day are made from many different types of plastic including parts of computers and cars, beverage containers, shampoo and ketchup bottles, compact disc cases and trash bags.) Do you recycle your soft drink and water bottles at home and school? Find out the types of plastics that can be recycled in your community. **Ask:** What products are made from recycled plastic? (Clothing and carpet can be made from soft drink and water bottles. Laundry detergent containers, recycling bins, pens and floor tiles can be made from milk, water and juice containers.)

**METAL:** About 9.0 percent by weight of everything we generate is metal.

- Metal (which include steel and aluminum cans and appliances) was the No. 5 category of the nation's MSW stream in 2010. Americans generated about 22.4 million tons of metal before recycling.

- About 35.1 percent (7.87 million tons) of metal was recycled.

  **Ask:** Do you recycle aluminum and steel (food) cans at home? Does your school have an aluminum can recycling program? Does your school cafeteria recycle its food cans?

**RUBBER, LEATHER AND TEXTILES:** About 8.4 percent by weight of everything we generate is rubber, leather and textiles.

- Rubber, leather and textiles (which include tires, clothing) comprised the No. 6 category of the nation's MSW stream in 2010. Americans generated 20.9 million tons of rubber, leather and textiles before recycling.

- About 15 percent (1.1 million tons) of rubber and leather were recovered for recycling. About 15 percent (1.97 million tons) of textiles were recycled.

  **Ask:** Can tires be recycled? (Yes. In fact, it's the law in South Carolina. They are the No. 1 source of rubber in the nation's MSW stream.) What can be done with old tires? (They can be used for fuel at cement kilns and paper mills. They can be used in road-paving and landscaping applications. In addition, old tires can be used to make running track surfaces and mats that go under playground equipment. This can make a playground or schoolyard a much safer place for children to run and play.)

**WOOD:** About 6.4 percent by weight of everything we generate is wood.

- Wood (which includes furniture, crates, pallets, etc.) comprised the No. 7 category of the nation's MSW stream in 2010. Americans generated 15.88 million tons of wood before recycling.

- About 14.5 percent (2.3 million tons) of wood was recovered for recycling.

  **Ask:** What are some sources of wood waste? (Examples include furniture, cabinets for

electronic equipment as well as wood packaging like crates and pallets.) What can be done with furniture instead of throwing it away? (Give it to charity. Sell it at a garage sale.)

**GLASS:** About 4.6 percent by weight of everything we generate is glass.

- Glass (which includes beverage and food containers, electronics and furniture) comprised the No. 8 category of the nation's MSW stream in 2010. Americans generated 11.53 million tons of glass before recycling.

- About 27.1 percent (3.13 million tons) of glass was recovered for recycling.

  **Ask:** What happens to most recycled glass bottles? (Most are used to make new glass bottles.) How long can glass bottles be recycled? (Glass can be recycled forever.)

**MISCELLANEOUS:** Other types of waste make up 3.4 percent by weight of everything we generate. The Miscellaneous category includes any type of waste not mentioned in the previous eight categories.

- In 2010, Americans generated 8.63 million tons of miscellaneous waste.

- About 29.4 percent (1.41 million tons) of miscellaneous waste was recycled.

## Questions for the Class

1. List the contents of the average family garbage can.

2. If each person throws away an average of 3.6 pounds of garbage from their household and school every day, how much is each family throwing away each day? Each class?

3. Where does the family garbage go?

4. What are some ways to reduce the amount of garbage being thrown away from each home and school?

## Extension Activities

1. South Carolina has both urban and rural areas. How is the trash different in these areas? How is it the same? How is it disposed of differently? Have students research and discuss.

2. Have students become "Garbologists" for a day. Have them investigate the contents of their family garbage can to discover what our trash tells about us. Write a paragraph about what we eat, what we buy and our lifestyle.

# MUSICAL RESOURCES

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- identify natural resources; and
- see how natural resources are depleted by the things we buy and use each day.

## Background

**Natural resources** are useful materials from the Earth, such as water, coal, oil, natural gas and trees. **Nonrenewable resources** are those that become depleted more quickly than they naturally regenerate (for example, oil and mineral ore). Once mined and used completely, they are gone forever. **Renewable resources** (for example, trees, fresh water, sun, wind) are those that can be replenished at about the same rate at which they are used. Given the fact that many of our natural resources are **finite**, that is, limited in number, it is important that we reduce our use of these resources to make them last.

People use natural resources as **raw materials** to manufacture or create products and conveniences that we use everyday. Water and food, for example, provide people with nourishment and energy while fossil fuels are used to provide energy for transportation, heating and manufacturing. It also is important to remember that many of the natural resources that people use are important for plants and wildlife to survive as well.

Resources used for the first time are called **virgin materials** and their extraction, processing and use require energy and can create pollution. **Resource recovery** is a practice that conserves natural resources by extracting material (e.g., paper, glass, aluminum and steel) and energy from the waste stream and reprocessing them for reuse.

Recycling saves natural resources like minerals, trees and water. When 1 ton of steel is recycled, about 2,500 pounds of iron ore, 1,400 pounds of coal and 120 pounds of limestone are conserved.

Recycling also reduces or eliminates pollution by lessening the need to extract, move and process raw materials.

*Continued on the following page*

## Learning Essentials

**Focus:** Dwindling natural resources

**Subject:** Science

**Extensions:** Language Arts, Music, Physical Education

**Materials:** Chairs equal to half the number of students, 10 to 15 assorted objects (see the list in the Learning Procedure), index cards, crayons, music and player, a bag

**Teaching Time:** One class period

**Vocabulary:** Consumption, finite, natural resources, nonrenewable resources, petroleum, raw materials, renewable resources, resource recovery, virgin materials

**Lesson Resources:** "Natural Resources"

Manufacturing products from recycled material almost always saves energy. It takes 95 percent less energy to make aluminum from recycled aluminum than it does to make it from the virgin material bauxite. It takes 70 percent less energy to make recycled plastic, 60 percent less energy to make recycled steel, and 40 percent less energy to make recycled newsprint or recycled glass.

There are many ways each of us can conserve resources including reducing our **consumption**, that is reduce what we buy or buy things with less packaging, reuse what we can, compost and recycle as much as possible.

This activity is similar to Musical Chairs. Chairs represent natural resources and, as they are used and depleted, chairs are removed. Everyone, however, remains in the game and more people are added to simulate the growing population. The students must share chairs to demonstrate increasing stress on our diminishing supply of natural resources.

## Learning Procedure

1. Arrange the chairs to fill a large circular area representing the Earth. There only should be enough chairs for half the students. To start the game, there will be a chair for each beginning player.

2. Tape an index card with the name of a resource to each chair. See the sample cards included with this lesson. Some resources may have to be used more than once.

3. Tell the students they represent the people of the world and the chairs represent the resources of the Earth.

4. Place 10 to 15 objects in a bag – aluminum can, glass jar, perfume bottle, pencil, plastic bottle, paper clip, leather belt, penny, steel can, sock, etc. Select items that represent a wide variety of natural resources and items that the students can identify with buying and owning.

5. Have half of the students sit in the circle of chairs. Have each student choose an item from the bag representing resources. The other half of the class also should participate in the discussions.

6. Going around the circle, ask each student to name the natural resource and/or raw material used to produce it. NOTE: The students may need help with naming the basic raw materials used. For example, plastic is made from oil (**petroleum**) – a nonrenewable resource.

7. Make a list of the natural resources the students name. Discuss whether they are renewable (cotton, trees) or nonrenewable (aluminum, copper).

8. Tell students sitting in the chairs that they are the people of today's world (the players) and the other half of the class are the people of the future. They will sit out and watch until they are "born" and called upon to play. Give each student in both groups a crayon to use later in the game.

9. When the music plays, the people will walk around in a circle, similar to Musical Chairs. While there are a finite amount of resources, there are plenty of resources for everyone at the beginning of the game. When the music stops, everyone will find a place to sit. At this time, each player is instructed to color one of the little squares on the card where he/she is sitting to represent a portion of the consumption of that particular resource. **Ask:** What resource are you consuming and what is it used to make?

10. When the music begins, the procedure is repeated. Again, instruct the players to find a chair (resource) and color a square when the music stops.

11. Before starting the music a third time, tell the students that there are more and more people being born every day, so add three or four new members to the world's population. Begin the music. This time when the music stops, there will not be enough chairs for each student to have his/her own, so those left without one must find someone who is willing to share his/her chair. Again, each person must color a box on their chair's card. Chairs holding two people will receive two marks on the card. Chairs holding three, three marks and so on. Everyone must be sitting before the music begins again.

12. Repeat the procedure, adding additional players with each new round. WHEN ALL THE SQUARES ON ANY ONE CARD ARE FILLED IN, THE CHAIR IS REMOVED FROM THE EARTH. This is to represent the consumption of that natural resource. Continue this process until almost all the chairs are gone and all the students are balancing several people deep on the remaining chairs.

## Extension Activity

Play musical resources again, but this time when a player reaches a chair, give the student the option of stating a way the resource can be recycled or conserved. If the player can think of a way to conserve (not consume) the resource, the box on that turn will not have to be colored.

The game can go on indefinitely when the resources do not have to be consumed. Remind students that even renewable resources need wise conservation.

## Questions for the Class

1. What would happen if the game continued and we kept on populating the Earth and consuming our natural resources?

2. Was it sometimes difficult finding someone to share a chair? Do countries have difficulty sharing resources?

3. How did it feel to be crowded on one chair? How did you feel when a resource (chair) was removed?

4. Is there a similar problem on Earth? Are some nations using resources more rapidly than others?

5. How could we preserve our natural resources? What can your school do? Make a list of ways to conserve our resources.

## BAUXITE (Aluminum) – NONRENEWABLE

| | | |
|---|---|---|
| | | |
| | | |

*This resource is used to make aluminum products such as cans, siding, automobile parts, window frames, etc.*

## COPPER – NONRENEWABLE

| | | |
|---|---|---|
| | | |

*This resource is used to make electrical wire for homes, factories, businesses, cars, computers, etc.*

## GOLD – NONRENEWABLE

| | | |
|---|---|---|
| | | |
| | | |

*This resource is used to make jewelry, electrical components, etc.*

| IRON ORE (Steel) – NONRENEWABLE | | |
|---|---|---|
| | | |
| | | |

*This resource is used to make food cans, cars, construction supplies, bicycles, etc.*

| WOOD – RENEWABLE | | | |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

*This resource is used to make paper, books, furniture, construction materials, etc.*

| PETROLEUM – NONRENEWABLE | | | |
|---|---|---|---|
| | | | |
| | | | |

*This resource is used to make gasoline, plastic, medicines, polyester and other fabrics, etc.*

| SAND – NONRENEWABLE | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |

*This resource is used to make glass, construction material, etc.*

| COTTON – RENEWABLE | | | |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

*This resource is used to make cotton fabric such as denim, rugs, some papers, etc.*

| FELDSPAR – NONRENEWABLE | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |

*This resource is used to make glass, insulation material, etc.*

| TIN – NONRENEWABLE | | |
|---|---|---|
| | | |

*This resource is used to make metal alloys, electronics, etc.*

| SILVER – NONRENEWABLE | | |
|---|---|---|
| | | |
| | | |

*This resource is used to make jewelry, electronics, photographic films, etc.*

MATH
HISTORY
SCIENCE

# MY BAG

| PREPARATION TIME: | MODERATE |
|---|---|

## Learning Objective

Students will identify waste that can be recycled, reused, rejected, repaired and composted.

## Background

What you call **trash** or garbage, professionals call solid waste. There are different kinds of solid waste, but the most common type measured is municipal solid waste (MSW). What is MSW? MSW is the garbage we make in our homes, places of work and schools. In South Carolina, MSW is defined as the combined residential, commercial, institutional/ non-profit and industrial packaging/office waste we make. South Carolinians generate about 5.0 pounds of MSW each day. Of that amount, about 3.6 pounds is disposed of in Class 3 landfills. We **recycle** the rest – about 1.4 pounds per person per day.

Recycling is a smart waste management option that conserves natural resources and reduces the need to build landfills or incinerators. Other smart waste management options are to **reuse** or **compost**. When implemented, waste is removed from the MSW stream and is not disposed of in our **landfills**.

In this activity, students look into a typical bag of household trash and decide which items can be recycled, reused, **rejected**, repaired and composted as well as those that must be thrown away.

## Learning Procedure

1. Show students the bag of trash you have prepared and ask them to **estimate** its weight. Call on several students to estimate from just looking at the bag and then from holding the bag. Weigh the bag. Using a bath scale, weigh the person with the trash bag and weigh the person without the trash bag. Then subtract to obtain the weight of the trash bag. Your answer should be about 5.0 pounds. Tell students that this is how much trash each one of us generates each day. Students may find this unbelievable. Remind them that this figure includes trash from all of their meals, classroom waste, etc. It is just the MSW that we make. It does not include any of the waste from an industry's processing or manufacturing operations.

*Continued on the following page*

## Learning Essentials

**Focus:** Recycling

**Subject:** Science

**Extension:** Math, Physical Education

**Materials:** About 5 pounds of clean trash (including items that can be recycled, reused, rejected, repaired or composted – also have items that only can go in the landfill/ incinerator), six clean paper bags, bath scale

**Teaching Time:** 30 to 45 minutes

**Vocabulary:** Compost, estimate, landfills, recycle, reduce, rejected, reuse, trash

**Lesson Resources:** "Garbage 101" and "Recycling 101"

2. Make six cards marked RECYCLE, REUSE, REJECT, REPAIR, COMPOST and LANDFILL. Tape these cards onto the six bags. Discuss what these words mean. Find out and discuss with the class what is recyclable in your community. For more information, visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE.

3. Have the students open the trash bag and tell what each item is used for and why it was purchased. Discuss if the product was necessary or not. Now that the item is trash, was it worth buying the product in the first place? Remind students that we can **reduce** the amount of trash we throw out by only buying what we need.

4. Have students divide the contents of the trash bag into the proper categories – RECYCLE, REUSE, REJECT, REPAIR, COMPOST and LANDFILL.

5. After classifying, re-weigh the items in the landfill category and discuss how much trash was saved from going to the landfill.

6. As a math exercise, create a chart graphing the weight of the six bags after the 5.0 pounds of trash has been sorted into recycle, reuse, reject, repair, compost and landfill.

7. As another math exercise, ask the class to multiply 5.0 pounds by the number of students in the class and school.

## Teacher's Answer Key for Student Worksheet

| | |
|---|---|
| F | Trash |
| G | Litter |
| A | Reuse |
| C | Reduce |
| J | Natural Resources |
| I | Landfill |
| H | Recycling |
| B | Paper |
| D | Reject |
| E | Compost |

## Extension Activities

1. Older children may play a recycling relay race. Divide the class into teams. Each child picks an object from a bag of mixed clean trash and delivers it to a box or bag labeled RECYCLE, REUSE, REJECT, REPAIR, COMPOST and LANDFILL. Each student must justify their decision.

2. Using a bag of clean, mixed trash, hand one trash object to each student and have all students stand together in a group representing the waste stream. The teacher can be the trash collector who will take the trash away to a landfill, one item at a time. Tell students that, at a landfill, they will be put into a specially lined hole in the ground and covered with soil. They will remain there forever. There's no light and virtually no air, so there's very little decomposition. Ask if anyone wants to go to the landfill. If they don't and want to reuse the resource, have them think of a way the item can be reused or recycled. Try to keep items out of the landfill by thinking of alternatives. Discuss ways to change the items that cannot be recycled or reused. Continue until all the students/trash items are taken out of the landfill.

3. Have students (and teacher, too) tie a plastic bag to their waists. Each student is to place in the bag all the waste from the class, clean and dry lunch waste and any other waste each student is responsible for making. Compare the amounts at the end of the day or week. You could try this both before and after this lesson to demonstrate how the students' habits may change.

4. Have students complete the "If bagging trash is your game, THIS MATCH IS FOR YOU" Student Worksheet.

5. Go back through the RECYCLE bag and REUSE bag and discuss what is in them and why.

6. Encourage students to pack waste-free lunches. Consider providing a "green" snack or a class party.

**Student Worksheet** Name: _____

# If bagging trash is your game, THIS MATCH IS FOR YOU!

Match each word on the left with the phrase that best describes it.

| | | |
|---|---|---|
| ___ **Trash** | A. | To find a new use for something instead of throwing it away. |
| ___ **Litter** | B. | A recyclable material made from trees. |
| ___ **Reuse** | C. | To buy less and to throw away less trash. |
| ___ **Reduce** | D. | To stop purchasing an item in a container or package that is not recyclable. |
| ___ **Natural Resources** | E. | Leaves and grass clippings that are broken down by natural processes and can be used on gardens. |
| ___ **Landfill** | F. | Our garbage, all the things we throw away. |
| ___ **Recycling** | G. | Trash that is in the wrong place, such as on the ground or in the street. |
| ___ **Paper** | H. | A process that makes something new out of something old. |
| ___ **Reject** | I. | A special place where trash is buried. |
| ___ **Compost** | J. | Things that are found in nature that we must have to live. |

MATH
HISTORY
SCIENCE

# NATURAL OR MAN-MADE?

**PREPARATION TIME:** **MODERATE**

## Learning Objective

Students will distinguish between things that occur naturally in our environment and things that have been made by man.

## Background

Ultimately, everything we use comes from **natural resources** – materials that are naturally occurring in the world. It's important that we learn to recognize the difference between items that are **natural** and those that are **man-made**, that is, natural objects that, through some human manufacturing process, have been changed into another object. This is the first step in recognizing the importance of our natural resources.

## Learning Procedure

1. Gather a variety of materials produced by nature and things made by people. You may bring these things to class or ask students to bring items to school.

2. Make simple signs to indicate the two categories, NATURAL and MAN-MADE. For example, the natural sign may include a tree with the sun overhead and the man-made sign may be a simple stick figure.

3. Have the students look at the signs and discuss the difference between things that are natural and man-made.

4. On a table, group items into two piles – one natural and the other man-made. Place the correct sign behind each pile. Hold up items one at a time and ask students to explain why the item is natural or man-made. NOTE: Items that are produced by people using natural materials are classified as man-made. This would include items such as pencils or paper.

5. Take all items off the table and place them in a box. Ask a student to remove an item and place it next to the correct sign – natural or man-made. Continue until all items have been categorized or until all students have participated.

*Continued on the following page*

## Learning Essentials

**Focus:** Natural and man-made things in the environment

**Subject:** Science

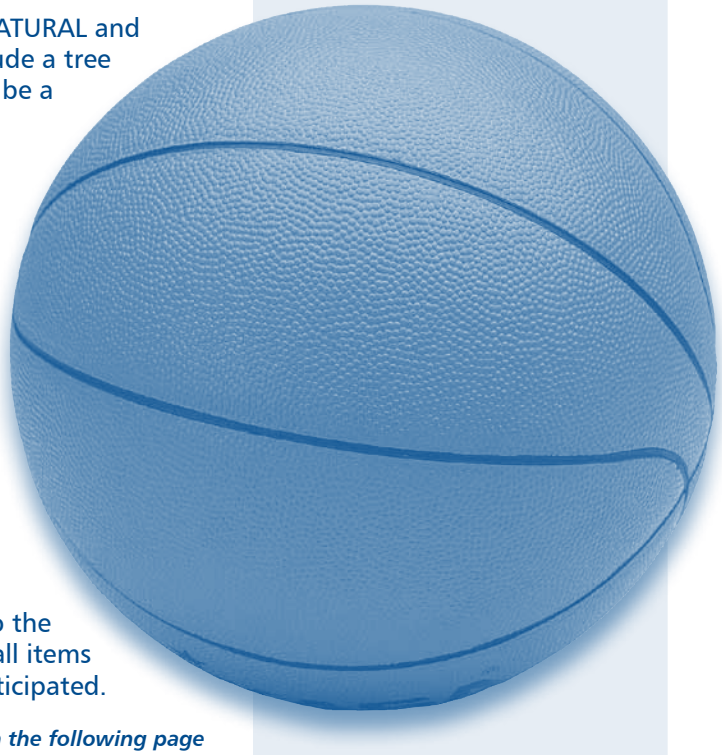
**Extension:** Social Studies

**Materials:** Natural items – leaves, rocks, seeds, fruit, wood – and man-made items – ball, pencil, book, glass, cardboard, plastic bags, etc. and a box

**Teaching Time:** One to two class periods

**Vocabulary:** Man-made, natural, natural resources

**Lesson Resources:** "Natural Resources"



6. Lay all items on a table. Instruct the students to use their senses of touch and smell only to identify natural from man-made items. **Ask:** Can senses of touch and smell be used to distinguish between natural and man-made objects?

7. Develop a learning center to display natural and man-made objects collected by students. Each day have one student bring two items for the center. The student should sort the items into the proper category.

## Extension Activities

1. Take a nature hike and have students collect samples of natural materials such as leaves, rocks, etc. Make a classroom poster of natural items.

2. Make a "mystery box" by cutting a hole in a box just big enough for a child's hand. Put an object in the box. Instruct students to try to determine by touch alone whether the object is natural or man-made. Change the item often and keep the box in your learning center with the other display.

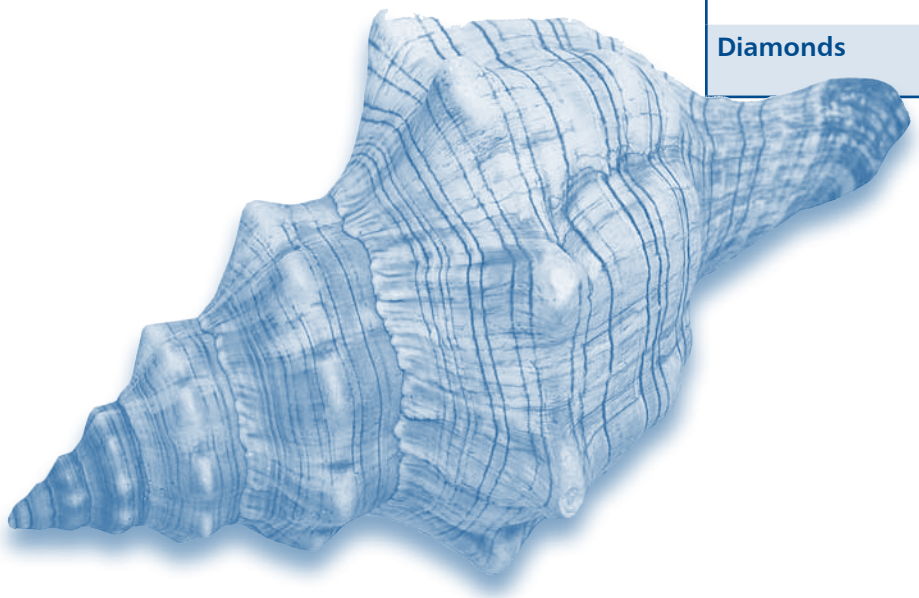
3. For more advanced students, you might want to discuss the concept that sometimes an object, such as a pencil, can be both natural and man-made.

4. Make a "Natural and Man-made" display for other classes in your school.

## Products Made from Natural Resources

People use an abundance of resources to survive in a continually developing world. Globally however, some people live simpler lifestyles than others and therefore use fewer resources. The following table lists some natural resources and the products and services people produce from them.

| NATURAL RESOURCE | PRODUCT/SERVICE |
|---|---|
| **Trees** | Paper, furniture, fuel |
| **Cotton plant** | Clothing |
| **Oil/petroleum** | Plastic, fuel |
| **Gas** | Fuel |
| **Coal** | Fuel |
| **Iron ore** | Steel products (cans, bridges) |
| **Bauxite ore** | Aluminum products (cans, car parts) |
| **Gold** | Jewelry, dental material |
| **Copper** | Wire, coins, electrical equipment |
| **Manganese** | Steel, cast iron |
| **Cobalt** | Steel, jet engine parts, cutting tools |
| **Platinum** | Air pollution control and telecommunications equipment, jewelry |
| **Chromium** | Stainless steel, green glass, gems (rubies and emeralds), leather treatment |
| **Diamonds** | Jewelry, mechanical equipment |



# POPULATION AND GARBAGE

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- understand that population growth can place more stress on natural resources and the environment; and
- see that population growth also results in more waste being generated that has to be properly managed (e.g., recycled, disposed of or sent to an incinerator).

## Background

About 4.6 million people live in South Carolina according to the U.S. Census Bureau. That represents a **population** increase of about 33 percent from 1990 to 2010. To illustrate 4.6 million people, note that the University of South Carolina's Williams-Brice Stadium holds about 80,000 people. It would take about 58 stadiums to hold the entire population of the state.

The **population growth rate** places stress on the environment and natural resources. There are more cars, trucks and sport utility vehicles and therefore more gasoline used and more emissions that impact air quality. There are more people needing water and there is more wastewater generated. There is more energy used. There are more homes and schools being built. There also is more garbage created.

There are many variables that factor into the amount of waste we make. The economy has a strong impact on consumption and **garbage generation** – a good economy means more garbage. Our lifestyle impacts the amount of waste generated. Today, we rely much more on products and services that are convenient than we did in the past – like fast-food restaurants, single-serve products and food that can be prepared in a microwave.

Climate is a variable as well. Longer, warmer seasons generate more yard trimmings. Waste generation can be seasonal – we make more garbage during the holidays.

Natural disasters like hurricanes, floods and tornadoes result in huge amounts of waste in a short amount of time.

Another variable is tourism, which is a significant part of South Carolina's economy. About 33 million people visited the state and spent about $10 billion in 2008 according to the S.C.

*Continued on the following page*

## Learning Essentials

**Focus:** The effects of population growth on garbage

**Subject:** Science

**Extension:** Math

**Materials:** "Population & Garbage" Student Worksheet

**Teaching Time:** Two class periods

**Vocabulary:** Garbage, generation, municipal solid waste, population, population growth rate

**Lesson Resources:** "Garbage 101," "Landfill 101," "Natural Resources"

Department of Parks, Recreation and Tourism. They also created more garbage.

None of those variables has the long-term impact that population growth has on the amount of waste generated. It's very simple – more people make more garbage.

The amount of **municipal solid waste** (MSW – the combined residential, commercial and institutional waste) generated in the United States has nearly tripled since 1960 growing from about 88 million tons to about 250 million tons in 2010 according to the U.S. Environmental Protection Agency (EPA). In 1960, every American made about 2.68 pounds of MSW per person per day. That amount has increased in each decade since and in 2010 was 4.43 pounds per person per day.

Overall, South Carolinians generated about 4.2 million tons of MSW in fiscal year (FY) 2011 (July 1, 2010 to June 30, 2011). In addition, each of us made 5.0 pounds of MSW per person per day in the state.

## Learning Procedure

1. Use the "Population & Garbage" Student Worksheet for this section. If each South Carolinian makes 5.0 pounds of MSW per day, determine how much each person makes in a week and a year. How much does each student's family make? (Each of us makes 35 pounds per week and 1,825 pounds per year. A family of three makes 5,460 pounds per year and a family of four makes 7,280 pounds per year.)

2. MSW is managed in two ways in South Carolina: it is disposed of in a Class 3 landfill or recycled. Of the MSW disposed of in a landfill, assume that 1,300 pounds of waste can be compacted (crushed) into 1 cubic yard of landfill space. How many cubic yards of landfill space are required per person per year? (Each of us uses about 1.4 cubic yards of landfill space per year.)

3. South Carolina's population is about 4.6 million people. Each South Carolinian makes about 5.0 pounds of MSW per day. That means we make 23 million pounds of garbage each day. Given that, how many football fields (100 yards long and 56 yards wide) would be filled to a height of 3.3 yards in a day? [Based on the formula that on average 1,300 pounds of garbage can be compacted into 1 cubic yard of a landfill, South Carolinians fill 17,692 cubic yards per day. That is the equivalent of nearly filling one football field.] **OPTIONAL:** Take the students to a football field to visualize the amount of waste.

4. Review South Carolina's population growth by decade since 1960. Review the EPA figures for waste generation per person per day by decade since 1960. Determine (realizing this is an estimate) how much waste was generated in South Carolina in each decade. Create a bar graph showing the growth in waste generation by decade.

## Questions for the Class

1. Compare South Carolina's population growth with those for the United States (or a single state of the students' choosing). What similarities and differences exist?

2. Is South Carolina's population concentrated in just a few areas? Use recent South Carolina population figures and an outline map of the state to identify the largest concentrations of people. Where would you expect to find the most garbage?

3. Find out how the population in your town and county is projected to change over the next five, 10 and 20 years. How will this population projection impact waste management in your community?

**NOTE:** For population estimates, visit **www.factfinder.census.gov**.

## Extension Activities

1. Write a paragraph that describes the relationship between population growth and the amount of MSW made.

2. Write a brief report with your ideas about how South Carolina should/could balance population growth with the stress on the environment and natural resources as well as the increase of MSW.

**Student Worksheet** Name: _____

# POPULATION & GARBAGE

| YEAR | TOTAL MSW GENERATED IN THE U.S. | TOTAL MSW GENERATED PER PERSON PER DAY IN THE U.S. | UNITED STATES POPULATION | SOUTH CAROLINA POPULATION |
|---|---|---|---|---|
| 1960 | 88.1 million tons | 2.68 pounds | 179.3 million | 2.4 million |
| 1970 | 121.1 million tons | 3.25 pounds | 203.3 million | 2.6 million |
| 1980 | 151.6 million tons | 3.66 pounds | 226.5 million | 3.1 million |
| 1990 | 205.2 million tons | 4.5 pounds | 248.7 million | 3.6 million |
| 2000 | 237.6 million tons | 4.51 pounds | 281.4 million | 4.0 million |
| 2005 | 245.7 million tons | 4.54 pounds | 288.4 million | 4.2 million |
| 2006 | 251.0 million tons | 4.6 pounds | 299.4 million | 4.34 million |
| 2007 | 254.0 million tons | 4.6 pounds | 301.6 million | 4.43 million |
| 2008 | 250.0 million tons | 4.5 pounds | 304.0 million | 4.5 million |
| 2009 | 243.0 million tons | 4.34 pounds | 307.0 million | 4.6 million |
| 2010 | 250.0 million tons | 4.43 pounds | 309.0 million | 4.6 million |

**NOTE:** Municipal solid waste (MSW) is the combined residential, commercial and institutional waste generated and includes paper, cans, food scraps, yard trimmings and packaging. The MSW figures are provided courtesy of the U.S. Environmental Protection Agency. The population figures are provided courtesy of the U.S. Census Bureau.

1. If each South Carolinian makes 5.0 pounds of MSW per day, determine how much each of makes in a week and a year. How much does each student's family make?

   _____

2. MSW is managed in two ways: it is recycled or disposed of in a Class 3 landfill. Of the MSW disposed of in a landfill, assume that 1,300 pounds* of waste can be compacted (crushed) into one cubic yard of landfill space. How many cubic yards of landfill space are required per person per year?

   _____

3. South Carolina's population is about 4.6 million people. Each South Carolinian makes about 5.0 pounds of MSW per day. How many football fields (100 yards long, 56 yards wide and 3.3 yards high) would be filled in a day?

   _____

4. Review South Carolina's population growth since 1960 in the chart above. Review the EPA figures for MSW generation per person per day since 1960. Determine (realizing this is an estimate) how much MSW was generated in South Carolina. Create a bar graph showing the growth in MSW generation over time. Draw your bar graph on the back of this page.

   _____

*The compaction rate is provided courtesy of Waste Management, Inc.

**Student Worksheet**

Name: _____

# STUDENT BAR GRAPH

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# RECYCLE – DON'T LITTER

**PREPARATION TIME:** **EASY-TO-DO**

## Learning Objectives

Students will:

- identify and evaluate ways that litter can endanger wildlife; and
- identify ways to help reduce these dangers.

## Background

South Carolina is known worldwide for its beautiful and diverse environment – from the foothills of the Blue Ridge Mountains to the more than 180 miles of sun-splashed, white sand beaches. The state's rich natural environment offers a variety of outdoor activities including world-class fishing and hunting, kayaking and canoeing black water rivers, hiking mountains wilderness trails, shooting rapids, and boating on lakes and ocean waters. South Carolina's outdoors is home to an amazing variety of plants and wildlife.

The state's environment plays a huge role in South Carolina's economy. Consider these figures. The total tourism value added $11.6 billion (about 7.6 percent) to the state's economy in 2007 according to the S.C. Department of Parks, Recreation and Tourism. The tourism economy generated total wages and salaries of about $7.3 billion.

Pollution and litter are dangerous to our wildlife, aquatic life, safety and economy. The threat is not imagined. According to the Ocean Conservancy, about 600,000 volunteers collected more than 8.3 million pounds of trash and litter from beaches and waterways in 114 countries (including 46 states and the District of Columbia) during the 2010 International Coastal Cleanup – the world's largest volunteer effort of its kind. The No. 1 debris item collected as part of the cleanup was cigarettes and cigarette filters – about 20 percent. Other examples of litter found includes plastic bottles, plastic bags, caps/lids, food wrappers/containers, glass bottles and paper bags.

In 2010, there were 32,834 days that beaches were either closed or under an advisory (equaling about 5 percent of the total available beach days) across the United States according to the U.S. Environmental Protection Agency. In comparison, during South Carolina's 2010 swimming season, actions were reported

*Continued on the following page*

## Learning Essentials

**Focus:** How litter effects wildlife and aquatic life

**Subject:** Science

**Extensions:** Math, Social Studies

**Materials:** Pictures from magazines or samples of litter (six-pack plastic rings, fishing line, plastic wrap, plastic bottles, gum wrappers, cigarette butts, aluminum cans, etc.), "Litter in the Wild" Student Worksheet

**Teaching Time:** Two class periods

**Vocabulary:** Debris, endanger, litter, littering, pollution

**Lesson Resources:** "Recycling 101"

less than 1 percent of the time, affecting one beach. The primary sources of ocean debris include storm sewers, illegal dumping, balloon releases, commercial and recreational boats and commercial shipping.

Debris is a problem for a number of reasons. Marine animals can become caught in discarded fishing nets and lines, grocery bags, six-pack plastic rings, ribbons and other floating debris. In addition, some animals mistakenly eat the man-made materials. Sea turtles, for example, consume floating trash bags and balloons, likely mistaking them for jellyfish. Several bird species have been found to swallow plastic pieces and cigarette butts. These materials damage the animals' digestive systems. They may stop eating because their stomachs feel full and starve to death.

On land, litter also **endangers** wildlife. Half-open food and soda cans are a problem for animals. Deer and raccoons can cut their mouths on cans and smaller animals can get their heads stuck inside the cans and starve to death. Many people are unaware of the injury, suffering and death they cause animals by throwing trash on the ground or into the water.

## Learning Procedure: Day One

1. Write the words litter, pollution and endanger on the board. Discuss with students and help them to define each word.

2. Discuss with the class how litter can harm wildlife and aquatic life.

3. Using litter items or pictures of potential litter items, have students discuss the potential harm each item could present in the wild. You may choose to rate items according to their potential harm.

4. Have students identify the most harmful object. Have students discuss each item's potential for harm.

5. Ask for volunteers to attach each picture or item to a large cardboard or art paper panel and draw in large numbers to show each item's rating as it is decided.

6. Assign students to look for pictures of items that often become litter and pictures of wildlife that can come in contact with litter and to bring them to class.

## Learning Procedure: Day Two

7. Divide the class into groups of four or five students. Have each group use its pictures to assemble a collage. When the collages are finished, have the students rate each piece of litter in their collage. If students bring in pictures of items that were not rated, have the group assign a rating.

8. One by one recognize each group. Have a group representative give the collage's total score. Have each group discuss the litter items on their collage and what could be done to prevent it. Write suggestions on the board.

9. Distribute the "Litter In The Wild" Student Worksheet and ask students to complete it.

## Extension Activities

1. Invite a wildlife expert to join the class for the discussion and to present examples of local **littering** that harms wildlife.

2. Display the litter collages in a local shopping center during National Wildlife Week – celebrated in April. For more information, visit **www.nwf.org/watch**.

3. Ask students if they want to start a six-pack plastic ring recycling program at school. There is a program available that allows students to learn about and participate in closed-loop recycling.

   The Ring Leader Recycling Program accepts all flexible six-pack plastic beverage ring carriers. It offers a free kit that includes a tree for collecting rings, educational materials and postage paid mailing labels. For more information, visit **www.ringleader.com**.

**Student Worksheet** Name: _____

# LITTER IN THE WILD

1. Name five types of litter.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

2. Name ways that litter can harm aquatic life and wildlife.

   a. _____

   b. _____

   c. _____

   d. _____

3. List three things you can do to reduce the litter threat to aquatic life and wildlife.

   a. _____

   _____

   _____

   b. _____

   _____

   _____

   c. _____

   _____

   _____

MATH
HISTORY
SCIENCE

# RECYCLE IT!

**PREPARATION TIME: MODERATE**

## Learning Objectives

Students will:

- understand the definition of recycle;
- understand that recycling is a three-step loop process;
- recognize the universal recycling symbol;
- identify items that can be recycled; and
- learn how to prepare items for recycling.

## Background

**Recycle** has many definitions. Recycle, in regards to waste management, means recovering and reprocessing usable products (e.g., **aluminum cans**, **newspapers**, **glass**, **plastic bottles**, etc.) that might otherwise become waste into new products.

Most of us think of recycling as simply placing **recyclables** into a recycling bin or taking them to a drop-off center. There is more to it than that. Recycling is a three-step process. The first step is collection – that's where recyclables are placed into the bin or taken to a drop-off center. The second step is manufacturing – that's when recyclables are processed into raw materials that are manufactured into new products. The third step is buying **recycled**. All three steps are necessary to make recycling work.

The most widely used recycling symbol in the world is the three **chasing arrows** ♻. The three arrows simply and clearly represent the three steps of the recycling process.

Some materials are easier to recycle than others. The most common recyclables are aluminum cans, steel (soup and food) cans, plastic bottles, glass and newspaper. Other common recyclables are cardboard and magazines.

Local governments collect recyclables as part of its waste management service. Some communities offer curbside collection – that is residents have recycling bins that can be placed on the curb to be picked up by a recycling truck (usually once a week). Many communities rely on drop-off centers where residents can take their recyclables. Some communities have a combination of both approaches. In addition, many communities have privately owned collection centers that pay for recyclables (usually, for example, aluminum cans or cardboard).

Many materials, while recyclable, may not be collected for recycling in your community.

*Continued on the following page*

## Learning Essentials

**Focus:** Recycling

**Subject:** Science

**Extension:** Social Studies

**Materials:** "Recycle Cycle" Student Handout, "Recyclable Items" Student Handout, recycling symbol, drawing paper, crayons or markers, products with recycling symbols, items that can be recycled in your community, magazines

**Teaching Time:** One or two class periods

**Vocabulary:** Aluminum cans, chasing arrows, glass, materials recovery facility, newspapers, plastic bottles, precycle, recyclables, recycle, recycled

**Lesson Resources:** "Recycling 101," "Residential Recycling: Back to the Basics"

## Learning Procedure 1

1. **Ask**: What does recycle mean? (Recycle means minimizing waste by recovering and reprocessing usable products that might otherwise become waste (e.g., recycling of aluminum cans, paper and bottles, etc.). Hold up an item that has a recycling symbol on it. Draw the symbol on the board. Explain that the symbol is made of three arrows in the shape of a triangle. Demonstrate that, if you start at one arrow and follow it, you go around in a loop. Explain that this loop represents how recycling works. Go through this process with several items, such as a plastic soda bottle or aluminum can. See "Recycle Cycle" Student Handout for the complete process.

2. Pass around products with recycling symbols. Explain to students that there are several versions of the recycling symbol. Ask students if they know the difference between recycled and recyclable. (Recycled means the item was made from material that already has been used. Recyclable means the item can be recycled and used to make something new.)

3. Discuss the importance of looking for the symbol when you shop. Explain that many people **precycle**. Precycling means that they buy products that can be recycled or reused as well as buying products made from recycled materials whenever they can.

4. Ask students to name items at home that can be recycled. List those recyclable items on the board.

5. Distribute "Recyclable Items" Student Handout and review.

## Learning Procedure 2

For this activity, concentrate on items that are recyclable in your area. (Visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE for a list of recyclables collected in your community.) Stress that as recycling becomes more available, more items will be recycled.

1. **Ask:** What's recyclable in our area? Discuss this with the class and explain the recycling options available. **Ask:** Do you recycle at home? What items? Where do they go?

2. Show examples of recyclable objects.

3. **Ask:** How do you prepare recyclables for collection? (Again emphasize methods in your area. Should aluminum cans be crushed? Should newspaper be bundled with string or placed in paper bags? Should milk and water jugs be crushed?) Also discuss methods to keep recyclables from becoming unsightly. (Remember to remove lids. Always rinse and dry containers to prevent attracting pests, etc.)

4. Ask each student to select a picture of a recyclable object from a magazine. Each child will explain to the class why the object is recyclable and how to prepare the item for recycling. Have the class make a large collage of all the items and display the poster.

## Extension Activities

1. Have students bring in items that display a recycle symbol and show which items are recyclable and which are made from recycled materials.

2. Have students make a "How to Recycle" book to take home.

3. Share the "Save! Sort! Recycle!" Teacher's Resource with the class. You may want to laminate for permanent use.

## Watch the Words

Beware of the word "recyclable," which is not the same as "recycled." Many products are recyclable, but what matters is what you can recycle in your local program.

When shopping, look for the chasing arrows on the products you buy. The first symbol simply means the product or package can be recycled. The second means 100 percent of the product or package is made from recycled materials. The third means the product or package is made from both recycled and virgin materials. Each symbol and meaning are shown below.

**RECYCLABLE**

**100 PERCENT RECYCLED**

**LESS THAN 100 PERCENT RECYCLED**

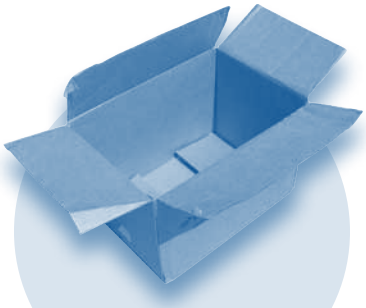
**Student Handout**

# RECYCLABLE ITEMS

Not everything is recyclable in every community. Visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE for a list of recyclables collected in your community.

**METAL**

**GLASS**



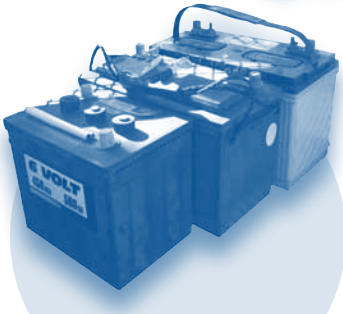
**CARDBOARD**

**PAPER**

**PLASTIC**

**ALUMINUM**

**USED MOTOR OIL**



**BATTERIES**

**TIRES**

Student Handout

# RECYCLE CYCLE

R-E-C-Y-C-L-E... it begins with you and me!

1. Enjoy your canned drink.
2. Rinse and place the empty aluminum can in the recycling bin or take to your local recycling drop-off center.
3. The can is taken to a **materials recovery facility** where it is separated from other recyclables and is sent to a processor.
4. The processor turns the can into a raw material to make a new can.
5. The new can goes to the soft drink bottling plant where they are filled again.
6. The new can is taken to a store for you to buy.

# SAVE, SORT, RECYCLE!

Make a copy of this page and color the recyclable items below. Then cut them out and paste them to the proper recycling squares on the other page. **OPTIONAL:** Have students divide real items shown on the handout into the appropriately labeled boxes.

# SAVE, SORT, RECYCLE!

| COMPOST | PLASTIC |
|---|---|
| | |

| ALUMINUM | SECOND-HAND SHOP |
|---|---|
| | |

| PAPER | GLASS |
|---|---|
| | |

# RECYCLING 101

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- understand the basic concepts of recycling; and
- understand the environmental and economic benefits of recycling.

## Background

**Recycling** is one of the nation's best environmental success stories.

But just what is recycling? Recycling is a three-step process. The first step is collection – that's when the **recyclables** are placed in the bin or taken to the recycling drop-off center. The second step is manufacturing – that's when recyclables are processed into **raw material** that are manufactured into new products. The third step is buying recycled. That's what completes the **recycling loop**.

Why recycle? Recycling is good for the environment, human health and the economy. The recyclables you place in your curbside bin or take to a recycling drop-off center have value. By turning waste into materials and products that can be bought and sold, recycling creates jobs and adds significantly to the nation's economy. Recycling promotes the sustainable use of natural resources. Recycling saves energy. Recycling reduces pollution. Recycling lessens the need to build landfills and incinerators.

Local governments design and run programs that need participation to be successful. People can recycle at home, work or school – just about anywhere.

There are some materials that have to be recycled by law in South Carolina – car (lead-acid) batteries, large appliances, tires, motor oil and household electronics (computers, computer monitors, printers and televisions). Yard trimmings cannot be disposed of in a Class 3 landfill and should be recycled, but frequently are disposed of in another type of landfill.

Local governments collect recyclables as part of their waste management services. Many communities offer curbside collection programs – that is residents have recycling bins that can be

*Continued on the following page*

## Learning Essentials

**Focus:** Recycling

**Subject:** Science

**Extension:** Social Studies

**Materials:** A collection of plastic samples

**Teaching Time:** One class period

**Vocabulary:** Glassphalt, raw material, recyclables, recycling, recycling loop

**Lesson Resources:** "Recycling 101," "Residential Recycling: Back to the Basics"

placed on the curb to be picked up by a recycling truck (usually once a week). Other communities rely on drop-off centers where residents can take their recyclables. Communities also may have privately owned buy-back centers (e.g., a business that buys aluminum cans from residents). Some communities offer a combination of all of these services.

Most recycling programs accept traditional recyclables such as aluminum cans, plastic bottles (soft drink, water, detergent, shampoo, milk etc.,) newspapers (including inserts), cardboard, steel cans (soup, fruit, vegetable and other food) and glass bottles (clear, green and brown). Many other programs also accept cardboard, magazines, office paper and unwanted mail.

Just what happens to the recyclables? Plastic bottles can become part of new plastic bottles, lumber, carpeting and clothing. Aluminum cans can become new cans and be back on the supermarket shelf within six weeks. Glass can be recycled forever into new glass containers as well as **glassphalt** (the asphalt that shimmers in the sunlight), road filler and fiberglass. All steel products contain recycled steel.

## Challenges of Recycling

Despite many successes, recycling has not reached its full potential. The most frequent complaint of local governments is that it costs more to collect recyclables than to simply throw away the material. Clearly, while there is always a cost with any waste management option, recycling programs must operate as efficiently as possible.

Lack of participation hurts many recycling programs throughout the country. More material collected consistently and without contaminants brings better market prices.

And finally, recycling facilities such as materials recovery facilities are not always welcome in communities. Residents are concerned about the noise, increased traffic and pollution.

## Learning Procedure

1. Discuss the recycling program in your community or school. What is collected? What isn't? How is it collected (curbside or drop-off center)? Where do the recyclables go after they are collected? Ask the county recycling coordinator to present to the class.

2. Have students research what types of products are made from their recyclables.

## Questions for the Class

1. What does recycle mean? (Recycle means minimizing waste by recovering and reprocessing usable products that might otherwise become waste i.e., recycling of aluminum cans, paper and plastic or glass bottles.)

2. What are some environmental benefits of recycling? (Recycling conserves natural resources, saves energy and reduces pollution associated with the mining and extraction of raw materials.)

3. What are some economic benefits of recycling? (Recyclables have value and recycling creates jobs and is good for the economy.)

4. Where can residents and students learn more about the recycling program in their community? (Visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE or call **1-800-768-7348**.)

## Extension Activity

Have students find out what educational efforts or materials are available to inform residents on what to recycle, where and who to call for more information. Have the students design materials (e.g., posters, brochures) to help get the word out on recycling.

# RECYCLING: A VALUABLE LESSON

**PREPARATION TIME:** **EASY-TO-DO**

## Learning Objective

Students will understand:

- the process and benefits of recycling;
- that managing waste costs money;
- that schools that recycle may save money in avoided disposal costs and may generate revenue from the sale of recyclables; and
- that most schools are able to recycle.

## Background

Why recycle at school? Let us count the ways.

First, as everyone understands, recycling is good for the environment and protects human health. Recycling conserves natural resources such as timber, minerals and water. Recycling saves energy. Recycling reduces pollution. Recycling lessens the need to build landfills and incinerators. Recycling reduces **greenhouse gas** emissions that contribute to global **climate change**.

Second, recycling is good for the economy. Recyclables have value. By turning recyclables into raw material and then recycled-content products, recycling creates jobs and adds significantly to South Carolina's and the nation's economy.

And finally, recycling is good for schools. Schools, of course, not only have the opportunity to reduce their waste, but also perhaps save money in **avoided disposal costs** and earn revenue from the sale of recyclables.

Schools are essential in making recycling work in South Carolina. School programs compliment local recycling programs, which, in turn, help the state meet its overall waste reduction and recycling goals.

*Continued on the following page*

## Learning Essentials

**Focus:** Recycling by schools

**Subject:** Science

**Extensions:** Economics, Math

**Teaching Time:** One class period

**Vocabulary:** Avoided disposal costs, climate change, greenhouse gases, sustainability, tipping fees, waste audit

**Lesson Resources:** "Recycling 101," "Buy Recycled ... and Beyond"

A school recycling program provides a learning experience for everyone. Students, teachers, staff, administration and parents can participate and learn the fundamentals of recycling. Students, in particular, learn life-long lessons on environmental stewardship and **sustainability**.

School recycling programs also support environmental lessons taught in the classroom as well as present a hands-on learning environment where students can learn individual responsibility,

Although there may be obstacles, most schools can recycle. The S.C. Department of Health and Environmental Control's (DHEC) Office of Solid Waste Reduction and Recycling can help schools set up, maintain and expand recycling programs through technical assistance, educational materials and grant funding. For more specific details, see "Starting a School Recycling Program: A Step-by-Step Guide to Help You Begin Recycling at Your School" at **www.scdhec.gov/environment/lwm/recycle/pubs/start_school_recycling.pdf**.

## Learning Procedure

1. Discuss with the class the importance of recycling and that schools have a unique opportunity to recycle and perhaps save money in the process.
2. Have the class complete a waste audit to find out what can be recycled. Typically, schools generate many of the same recyclables that are collected at home (e.g., aluminum cans, cardboard, paper, plastic bottles). School cafeterias also generate food scraps – some of which can be collected for composting. (See the techincal assistance sheet "Solid Waste Composting Guidance for Schools" at **www.scdhec.gov/environment/lwm/recycle/pubs/school_composting_tas.pdf**.) Divide the students into four groups and assign each group one of the sections on pages 103-106. Have each group answer as many of the questions in that section as possible. Identify how many students and faculty are at the school.
3. Based on the information collected during the waste audit, what recommendations do the students have to improve waste reduction and recycling at your school? Brainstorm specific ways the school can reduce the amount of waste it generates and determine how much money the school can save by putting those recommendations into place. (Example: start a composting program; ask PTO to purchase water bottles for the entire student body; encourage students to pack a waste-free lunch. Visit **www.epa.gov/osw/education/lunch.htm** to learn more.)
3. What local markets are available for recyclables? (For more information, visit **www.scdhec.gov/recycle** and click on RECYCLING MARKETS at the bottom of the page.)
4. Contact your local government recycling coordinator and ask for a presentation on recycling that will include information on other schools that have recycling programs as well as any recycling service that the local government may offer. Visit **www.scdhec.gov/recycle** (then click on RECYCLING WHERE YOU LIVE) for a county-by-county listing of recycling coordinators and programs.
5. Have students survey other schools in the district to see how many have recycling programs. If another school is recycling, ask: What materials are being recycled? How much is being recycled? Where are the recyclables going? What cost savings (avoided disposal costs) have occurred? What revenue, if any, has been earned from the sale of the recyclables?
6. Contact another school that has a recycling program and ask for a tour of the school and/or a presentation on its recycling program.

## Recycling may help schools save money.

Recycling may help a school or school district save money through avoided disposal costs. Remember, the less you throw away, the less you should have to pay to have waste hauled away. In many cases, schools do not know how often the dumpster gets filled and emptied. In many cases, garbage contracts are handled by the school's district office.

Waste management often is viewed as a line item in the school budget. Costs vary, but typically depend on the amount of waste that is generated and how often it is collected. The costs include landfill **tipping fees**, fuel charges, service fees and container rentals. This much is certain: again, the more a school throws away, the more it pays. For most schools, the cost is thousands of dollars per year.

Schools often can reduce that cost by taking the time to do a **waste audit** and assessing its waste management practices. By looking at the volume, source and type of waste being generated, schools can begin discussions on the best ways to mange this material.

# WASTE AUDIT

Name: _____

## SECTION 1: Trash Disposal at Your School

To answer the following questions, you may want to interview school personnel who manage the school's trash disposal service and/or review billing statements from the trash disposal service:

1. How many dumpsters for non-recyclables does your school have?
   ❑ 1-2 ❑ 3-4 ❑ 5-6 ❑ 7+

2. How often are they emptied?
   ❑ Daily ❑ Twice a week ❑ Weekly

3. On average, how full is each dumpster when it is emptied?

| DUMPSTER 1 | DUMPSTER 2 | DUMPSTER 3 | DUMPSTER 4 | DUMPSTER 5 | DUMPSTER 6 |
|---|---|---|---|---|---|
| ❑ Half full | ❑ Half full | ❑ Half full | ❑ Half full | ❑ Half full | ❑ Half full |
| ❑ Almost full | ❑ Almost full | ❑ Almost full | ❑ Almost full | ❑ Almost full | ❑ Almost full |
| ❑ Full | ❑ Full | ❑ Full | ❑ Full | ❑ Full | ❑ Full |
| ❑ Overflowing | ❑ Overflowing | ❑ Overflowing | ❑ Overflowing | ❑ Overflowing | ❑ Overflowing |

4. Who empties the dumpsters?
   ❑ Local Government (city, county) ❑ Private hauler ❑ Other: _____

5. What does your school pay for trash disposal services?
   Monthly: _____ Annually: _____

6. If figures are available from billing statements, how much garbage is thrown away by your school (tons or cubic yards)?
   Monthly: _____ Annually: _____

7. Where is the trash taken or where does it end up? Be specific.

_____
_____
_____
_____
_____
_____
_____
_____

Name: _____

## SECTION 2: Recycling at Your School

1. Does your school have a recycling program?
   ❑ Yes ❑ No

2. What is recycled at your school?
   ❑ Paper ❑ Aluminum cans ❑ Plastic bottles, jars and jugs
   ❑ Glass containers ❑ Printer cartridges ❑ Copier cartridges
   ❑ Computers ❑ TVs, VCRs, other electronics ❑ Other: _____

3. How many recycling containers does your school have?
   ❑ 1-25 ❑ 26-50 ❑ 51-75 ❑ 76-100 ❑ 101+

4. Where are recycling containers located at your school?
   ❑ Classrooms ❑ Hallways ❑ Cafeteria ❑ Playgrounds
   ❑ Gym ❑ Offices ❑ Copy rooms ❑ Athletic fields
   ❑ Other: _____

5. Who empties the recycling containers in your school building?
   ❑ Students ❑ Teachers ❑ Custodial staff
   ❑ Other: _____

6. How often are they emptied?
   ❑ Daily ❑ Twice a week ❑ Weekly

7. Does your school have an indoor area for storing recyclables?
   ❑ Yes ❑ No

8. Does your school have an outdoor area for storing recyclables?
   ❑ Yes ❑ No

9. Who picks up the collected recyclables and takes them to a recycling facility?
   ❑ City or county ❑ Private hauler ❑ Environmental club or other
   ❑ School staff ❑ No one (Volunteers take them to a recycling facility.)
   ❑ Other: _____

10. Where do your recyclables go after they are taken from the school? Be specific.
    _____

11. What does your school pay for recycling services?
    Monthly: _____ Annually: _____

12. Does your school receive any income from recyclables?
    ❑ Yes ❑ No
    If yes, how much? _____

Name: _____

## SECTION 3: Composting at Your School

1. Does your school have a compost program?
   ❑ Yes ❑ No

2. Does your school leave grass clippings on the lawn/athletic fields?
   ❑ Yes ❑ No

3. Does your school rake up leaves?
   ❑ Yes ❑ No

   If yes, what happens to them?
   ❑ They're composted at school. ❑ They're taken to a composting facility. ❑ They're taken to a landfill.

4. Does your school compost other yard trimmings (e.g., flowers, grass, weeds)?
   ❑ Yes ❑ No

   If yes, what is composted?

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

5. What does your school do with dead branches and tree limbs?

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

Name: _____

## SECTION 4: Purchasing, Reducing and Reusing

To answer the following questions, you may want to interview the personnel who manage the school's environmental policies and oversee the purchasing of school supplies. This may include contacting your school's district office.

1. Does your school or district buy recycled-content office paper?
   ❑ Yes ❑ No

2. Does your school or district buy other items made from recycled materials?
   ❑ Yes ❑ No

   If yes, list them.

   _____

3. Does your school or district buy items in bulk to reduce the amount of packaging and save money?
   ❑ Yes ❑ No

   If yes, list them.

   _____

4. Does your school save paper by:

   storing records electronically? ..... ❑ Yes ❑ No

   communicating via e-mail? ..... ❑ Yes ❑ No

   communicating via school Web site? ..... ❑ Yes ❑ No

   managing finances electronically? ..... ❑ Yes ❑ No

   giving tests online? ..... ❑ Yes ❑ No

   printing on both sides of the paper? ..... ❑ Yes ❑ No

   reusing scrap paper? ..... ❑ Yes ❑ No

5. Does your school reduce waste by:

   reusing large kitchen food storage containers? ..... ❑ Yes ❑ No

   serving food on reusable trays? ..... ❑ Yes ❑ No

   using metal silverware instead of disposable utensils? ..... ❑ Yes ❑ No

   donating unclaimed "lost" items to charity? ..... ❑ Yes ❑ No

   sponsoring swap days? ..... ❑ Yes ❑ No

   salvaging items for reuse when lockers are emptied at the end of the school year? ..... ❑ Yes ❑ No

6. When classes go on field trips, do they:

   recycle the cans and bottles they brought with them? ..... ❑ Yes ❑ No

   minimize the amount of trash they generate by using lunch boxes or cloth bags and reusable containers? ..... ❑ Yes ❑ No

# A ROTTEN IDEA

**PREPARATION TIME:** **EXTENSIVE**

## Learning Objective

Students will examine how some waste can be recycled by composting.

## Background

**Composting** is nature's way of recycling.

Composting is the natural decomposition of **organic material** (from plants and animals) such as leaves, yard trimmings, clippings and manure as well as fruit and vegetable scraps. Microorganisms break down this material into **compost**, a crumbly dark-colored, earthy smelling, soil-like material. That material is a nutrient rich product that can be used in your garden, flower beds and lawn.

Four basic ingredients are required for composting – greens, browns, water and air. Mixing the proper amounts of these ingredients together will provide the composting organisms (microbes and insects) with enough nitrogen, moisture and oxygen to break down the material effectively.

- GREENS include green leaves, fresh clippings and vegetable scraps.
- BROWNS include dead leaves, wood chips, dry twigs and paper.
- WATER is important. Too little moisture will inhibit the composting process. Too much moisture will cause the **compost pile** to smell. Here's a simple rule to follow – the compost pile should be as moist as a sponge.
- AIR is essential. Turn your compost pile once or twice a week to inhibit odor-causing bacteria and to speed up the composting process.

There are three main types of composting.

- Composting occurs naturally on forest floors as fallen leaves and tree limbs decompose. Nature replenishes itself this way without human intervention and returns nutrients to plants and trees.
- Composting can be done on a large-scale by municipal governments where trucks pick up yard trimmings and clippings from residents and take it to a central site where it is processed. The compost is sold or given to residents.
- Composting also can be done in your backyard or school.

*Continued on the following page*

## Learning Essentials

**Focus:** Composting, landfill, recycling

**Subject:** Science

**Materials:** Large clear plastic or glass jar, food scraps (fruit peels, bread), leaves, grass clippings, soil
NOTE: For the Compost Pile Cake, see the recipe included with this lesson.

**Teaching Time:** Variable

**Vocabulary:** Aeration, biodegradable, compost, composting, compost pile, decompose, organic material

**Lesson Resources:** "Backyard Composting"

Why composting? Why on Earth would anyone want to do that? There are lots of reasons.

Composting reduces the amount of waste a household generates. Yard trimmings and food scraps make up about 27.3 percent of the total amount of municipal solid waste households generate nationwide according to the U.S. Environmental Protection Agency (EPA). It also is important to remember that yard trimmings are **biodegradable** as well as generally clean and given that, disposing of them in landfills is unnecessary and a waste of space.

Compost is a valuable product. Compost improves soil by increasing **aeration** (the ability of air to circulate) and water-holding capacity – which reduces the need to water and helps plants absorb nutrients. Compost also suppresses plant diseases and pests.

Compost reduces or eliminates chemical fertilizer and pesticide use. That saves money as well as helps protect the environment by reducing runoff pollution to nearby streams, rivers and lakes.

Composting saves money. You save money by buying fewer bags for garbage and leaves. You also save money by buying fewer bags of compost from retail outlets. You make your own valuable product at home for free.

## Learning Procedure

1. Have students collect various food scraps from the cafeteria (no meat or cheese). Have them collect leaves and other plant materials from the school yard.

2. Place two inches of soil in the bottom of a clear plastic bottle such as a three-liter soda bottle. Poke several small holes in the sides for aeration. Moisten (like a damp sponge) for best results. Place food, leaves and grass scraps on top of the soil in several, repeating layers.

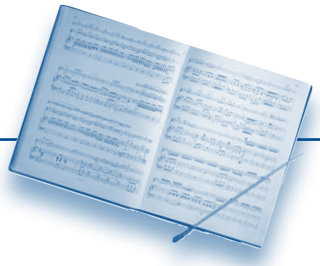
3. Leave the bottle open and place on a window sill or other location where it will not be disturbed. Observe the bottle daily, noting any changes. Water a little every week and stir contents.

4. On the first day, ask the students to record how the material looks and smells. You may want to do this as a group activity and keep a master log of their observations.

5. On the second day, ask students what they think is happening to the material. Introduce the term **decompose** as the items break down and rot. Have students observe the mixture for several weeks.

   **OPTIONAL:** Using several bottles, have students compare how different materials decompose. Use food scraps, yard trimmings, paper, plastic pieces, etc. in separate bottles. Have students observe how these materials vary in the way they decompose. Remind students that things do not decompose easily in the landfill where their trash goes. For things to decompose, they need air and water – things not found in a landfill.

6. Discuss with students the benefits of a backyard compost pile. (It reduces the amount of waste going to the landfill or incinerator and provides a rich soil amendment for home gardens.)



### Student Sing-Along

# BANANA PEEL BLUES

*(Sung to the tune of "Take Me Out To The Ball Game")*

Take me out to the compost;

Take me out to the heap.

Grind me up in a food grinder;

I don't care if I'm chopped up to bits,

Cause it's root root root for recycling;

If we all compost we'll gain.

For it's two, four, six weeks I'm out
to the old garden.

## Questions for the Class

1. What types of things decompose quickly in a compost bin? (Natural items such as yard trimmings and fruit peelings.)

2. Why should you keep yard trimmings separate from your household trash? (If separated, yard trimmings can be composted in your backyard or sent to a large-scale composting facility. This saves landfill space for items that do not decompose and can not be composted.)

## Extension Activities

1. Have students sing "Banana Peel Blues" and create new verses of their own.

2. Share "It's Fun To Make A COMPOST PILE CAKE" with students. This activity is a fun follow-up to your classroom composting experiment and shows students how things are layered in the compost pile to create something exciting. See the recipe for the Compost Pile Cake included with this lesson.

## Student Activity

# It's Fun To Make A COMPOST PILE CAKE!

As an extension activity, have students bring in ingredients and help prepare a Compost Pile Cake. Below are some ideas for creating the cake.

- Reinforce the importance of following directions and cooperating by having students bring the ingredients for the Compost Pile Cake and having students mix the ingredients.
- Divide the class into small groups to mix and prepare different layers of the Compost Pile Cake. Each student should have a task. Point out the skills used in making the recipe, such as measuring correctly (math), following directions (reading and listening) and have students observe changes and reactions (as in adding milk to the powered pudding mix). Ask the class what would the Compost Pile Cake taste like if an ingredient was missing, or if someone forgot to do his or her part.

## How to Prepare:

1. In a large bowl mix margarine and cream cheese until soft, add powered sugar (to taste) and mix well.
2. In another large bowl, mix well the milk, pudding mix and whipped cream.
3. Combine these two bowls and mix well.
4. In a large clear container such as a large glass salad or punch bowl, place Gummy Worms along the side of the bowl.
5. In the large clear bowl, alternate layers of crushed cookies (reserve about one cup), pudding mixture, nuts, coconut and cherries. Finish with a layer of cookies on top.

**NOTE:** For effect, serve the Compost Pile Cake to the class using a garden spade or small shovel. Feel free to adapt the recipe to meet your own tastes and dietary requirements.

## Ingredients:

- 1/2 cup margarine
- 8 ounces cream cheese, softened
- 1 cup powdered sugar
- 3 1/2 cups cold milk
- Two 3.4 ounce packages of instant vanilla pudding
- 12 ounces prepared whipped cream topping
- Six Gummy Worms (any flavor will do)
- One package of cream-filled chocolate sandwich cookies (crushed to simulate dirt)
- 1 cup chopped nuts (pecans or walnuts)
- 1 cup coconut (you may want to use green food coloring to simulate grass clippings)
- 1 cup chopped maraschino cherries

# WHEN THEY'RE GONE, THEY'RE GONE

**PREPARATION TIME:** **EXTENSIVE**

## Learning Objectives

Students will:

- learn and understand the value of natural resources;
- learn the difference between renewable and nonrenewable resources;
- investigate options for saving nonrenewable resources; and
- explore the distribution of natural resources around the world.

## Background

**Natural resources** are valuable, naturally occurring raw materials like minerals, trees, soil, water and coal.

Every day we use natural resources to take showers (water and energy to heat the water), to power our cars (oil), to build homes (trees) and more. As countries develop – that is become more industrialized – they consume more natural resources. Most developed countries buy and import natural resources from other countries. The United States is the world's top consumer of energy and one of the major consumers of natural resources.

**Renewable resources** are resources that can be replaced. Examples are trees, food and energy sources like solar power (sun), hydropower (water), wind and biomass (plant materials and animal waste that can be used as a source of fuel). The concept of renewable resources is sometimes blurred. Groundwater in deserts, for example, may take years to be replaced while it may take only a few days to replace groundwater in tropical rain forests. **Nonrenewable resources** cannot be replaced. Examples include fossil fuels such as oil, coal and ore deposits of metals.

Resource conservation is the wise use and management of natural resources to make them last longer. Resource recovery is the process of obtaining matter or energy from materials that had been discarded. Energy conservation is the practice of using less energy, both by using more energy-efficient products and by changing wasteful habits.

*Continued on the following page*

## Learning Essentials

**Focus:** Natural resources and wasteful use

**Subject:** Science

**Extension:** Social Studies

**Materials:** See the list provided

**Teaching Time:** Two class periods

**Vocabulary:** Natural resources, nonrenewable resources, renewable resources, sustainable development

**Lesson Resources:** "Landfill 101," "Natural Resources"

**Sustainable development** is an environmental strategy designed to protect natural resources. The goal of sustainable development is to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Recycling saves natural resources like minerals, water and timber. By decreasing the need to extract and process virgin materials, recycling helps reduce or eliminate pollution associated with the first two stages of a product's development: material extraction and processing. Recycling also saves energy. Studies have shown that less energy is needed to manufacture products from recovered materials than virgin materials.

## Materials

- A 2-pound coffee can (or a bag)
- Craft beads, buttons, small pieces of construction paper or candies in the following colors and quantities:
  - red ..... 400
  - blue ..... 104
  - pink ..... 31
  - green ..... 12
  - orange ..... 1
  - yellow ..... 1
  - purple ..... 1
  - clear ..... 1
- Six plastic cups
- Writing materials

## Learning Procedure

In this lesson, students will simulate the accumulation and consumption of the Earth's natural resources. They also will discuss the problems arising from the unequal and wasteful use of natural resources. Follow these steps to complete the lesson.

1. Discuss the background material provided with the class.

2. As a class, make a list of renewable and nonrenewable resources on the board. Explain that the beads (or selected material) represent nonrenewable resources. The number of beads represent the mineral's relative estimated total of abundance and not the ease that it can be obtained. Tell the students that these beads will be used in an activity later in the day.

3. Reproduce the "Distribution of Beads as the Earth's Resources" chart on the board.

4. Hide the beads throughout the classroom when the students are out of the room. Be sure to hide some in easy-to-find places and others in more difficult places.

5. Divide students into teams representing countries. To show increased potential in exploring for and money available to buy resources, vary the size of each group (United States 6, Russia 6, Germany 4, Japan 3, Canada 2, Zambia 1).

6. Give the teams time to explore for resources (beads). Have them collect the beads in plastic cups. First, give the students two minutes to search the room and then return to their group. Repeat the search a second time, but this time for only one minute. After each exploration, students should separate and consider their results based on the beads they have gathered in their cups.

7. Discuss the greater difficulty in finding resources during the second exploration time. (Competition becomes more intense for fewer resources.) Discuss real-life examples of countries competing for resources (e.g., conflicts in the Middle East and Africa are fought for control of oil reserves).

8. Beads in the cups represent natural resources that are manufactured into products, used and eventually discarded. Some natural resources are used for many years while other natural resources are used for a very short time and end up in the waste stream.

## Distribution of Beads as the Earth's Resources

| COLOR | NUMBER OF BEADS | NONRENEWABLE RESOURCE |
|---|---|---|
| Red | 400 | Iron in Ore |
| Blue | 104 | Bauxite (aluminum ore) |
| Pink | 31 | Chromium |
| Green | 12 | Copper |
| Orange | 1 | Lead |
| Yellow | 1 | Tin |
| Purple | 1 | Silver |
| Clear | 1 | Platinum |

9. Explain that much of what is thrown away is recyclable. Discuss the wastefulness of throwing natural resources into a landfill. For more information, see "Garbage 101" in the Lesson Resources.

10. **Ask:** What can we do to extend the life of nonrenewable resources? (Recycle.) What are the advantages of extending the life of resources? (More resources are available in the future so there may be fewer international conflicts, etc.)

## Questions for the Class

1. What will happen to the resources in the reserves if we continue this process? (We will eventually run out. There may be conflicts with the more technologically advanced continents winning. More powerful countries may try to gain the resources of less powerful countries through trade, aggression, etc.)

2. What can be done to stop wasting these resources? Make a list. [Recycle whenever possible, use less energy (It takes less energy to make new products from recovered materials than to produce new products from virgin materials.), reduce unnecessary packaging, etc.]

3. How did you feel about the unequal accessibility of the resources? Discuss the "fairness" of the situation.

4. How much longer could we extend the process if we recycle? What will happen if the population increases? Will it become more necessary to recycle?

5. Should the development of renewable energy sources (solar, wind, geothermal) be increased because of the finite status of coal, natural gas and oil?

6. Ask the following questions a few days after this exercise.

   - Did you use a product made from a renewable resource today? If yes, what was it? What did you do with the product when you were through with it?

   - Did you use a product made from a nonrenewable resource today? If yes, what was it? What did you do with the product when you were through with it?

   - What can you do to save natural resources?

7. Discuss the option of mining landfills to recover natural resources or energy (methane).

## Extension Activities

1. Research the nonrenewable resources represented by the beads in this lesson. What are the latest global reserve estimates and where are they found? For more information, visit **http://minerals.usgs.gov/minerals/pubs/mcs/2009/mcs2009.pdf**.

2. Develop and distribute recycling information on how recycling saves natural resources and energy to the community.

3. Hold a school assembly complete with skits and presentations by the students about the importance of resource conservation.

4. Have students pick a country and research its natural resources. Write a paragraph describing imports, exports and consumption.

5. Ask students to research sustainable development and present their findings.

MATH
HISTORY
SCIENCE

# WHERE DOES GARBAGE GO?

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- learn how much solid waste we generate each day;
- learn how solid waste is managed;
- learn that most of the solid waste we generate goes to a landfill; and
- learn that a landfill is a specially designed space to hold solid waste.

## Background

Each of us produces **garbage**. What you call **trash** or garbage, professionals call **solid waste**. There are different kinds of solid waste, but what we throw away from our homes, schools and places of work is know as **municipal solid waste** (MSW).

In South Carolina, each of us generated 5.0 pounds of MSW each day in fiscal year (FY) 2011 (July 1, 2010 to June 30, 2011). That's 1,825 pounds a year and about 7,300 pounds a year for a family of four. Overall, South Carolinians made about 4.2 million tons of MSW in FY11.

Where does the garbage go? Well, MSW is managed one of two ways. Most of it (about 72 percent or 3.6 pounds per person per day) is disposed of in Class 3 **landfills**. The remaining amount (about 28 percent or 1.4 pounds per person per day) was recycled.

In short, when you throw it away, where is away? Away is usually a landfill. Landfills are the most common form of waste disposal.

Just what is a landfill? Well, it is not a **dump**. And it is not just a hole in the ground. A landfill is a large area of land that is specially designed and built to receive waste. Federal and state regulations strictly govern the location, design, operation and closure of landfills in order to protect people and the environment.

*Continued on the following page*

## Learning Essentials

**Focus:** Waste management

**Subject:** Science

**Extensions:** Art, Language Arts, Social Studies

**Materials:** "Create a Mini-landfill" Student Activity Sheet, "Where Garbage Goes" Student Handout

**Teaching Time:** Two class periods

**Vocabulary:** Cell, dump, garbage, groundwater, landfills, leachate, methane, municipal solid waste, open dumps, solid waste, trash, water table

**Lesson Resources:** "Garbage 101," "Landfill 101"

Class 3 landfills – that accept MSW for disposal – must be located in areas away from land prone to earthquakes or flooding. The design of a Class 3 landfill includes hard plastic liners and other materials like clay to prevent **groundwater** contamination.

Nearby groundwater must be tested regularly and explosive gases such as methane must be collected. Some Class 3 landfills, including four in South Carolina, collect **methane**, a gas created by decomposing garbage, and convert it into an energy source.

How do Class 3 landfills work? The trucks that pick up the garbage from your curb or at a drop-off center, bring the garbage to the Class 3 landfill. The garbage is placed in a specific area called a **cell**, crushed (compacted) and covered with soil or other material to reduce odor and litter as well as control rodents and pests. (Refer to the "Where Garbage Goes" Student Handout.)

Landfills are expensive to build and operate. Beyond the expense, landfills are difficult to build simply because the public frequently opposes new construction. People remember the past poor practices of unlined, **open dumps** and are concerned about their health and environment as well as property values, noise, odors and traffic.

Reuse, reducing waste, recycling and composting all decrease the amount of garbage that otherwise would have to be disposed of in a landfill or sent to an incinerator. All of these waste management options save landfill space and reduce the need to build landfills.

## Learning Procedure

1. Invite the school custodian to talk to the class and ask about trash removing duties. **Ask:** How much of the day is devoted to removing trash? Where does the trash go? How often is it picked up? What makes up the trash? How much do we throw out each week? What does it cost to throw it out?

2. Arrange a short interview with the school's garbage hauler the next time they are scheduled for a pick-up. When the garbage truck comes, have the class watch the removal process. Then ask the garbage collector about the business. When do you start working in the morning and finish at night? How many truck loads of trash do you collect each day? Why is your truck designed the way it is and how does it work? How many schools, houses and businesses do you collect from each day? How many miles do you drive each day? Do you pick up recyclables separately? Why or why not? Where do you take the garbage? What happens to the garbage?

   **OPTIONAL PROCEDURES FOR STEPS 1 AND 2:** If scheduling a custodian or garbage hauler proves to be inconvenient, you may want to interview them yourself outside of class and role-play the parts with the class.

3. On the basis of the interviews, have the class construct a mural depicting all the stages in creation, collection and disposal of garbage. Add specific facts learned in the interview and display the mural in the school to teach others.

## Questions for the Class

1. Why are custodians and garbage haulers important?

2. Where does the school's garbage go?

3. What happens to it after it gets there?

4. Why is it necessary to take our trash to a special place? Why not just leave it in the backyard or by the side of the road?

5. How is a landfill different from a dump?

## Extension Activities

1. Take a trip to the local landfill to see how it works and how big it is.

2. Have students conduct interviews with the cafeteria staff to determine how much food waste is made at your school.

3. Does your school have a recycling program? If so, how much and what does it collect? If not, can you start one? Does your school have a composting program for food waste? If so, how much and what does it collect? If not, can you start one?

4. Have students create a mini-landfill. See the "Create a Mini-landfill" Student Activity Sheet.

Student Handout

# WHERE GARBAGE GOES

## A Trip to the Landfill

In South Carolina, an average family of four throws away about 101 pounds of garbage each week.

In many areas, each household has a roll cart garbage container or bags to put garbage in for collection by trucks that come by on a regular schedule.

## Step-by-Step

1. Garbage is picked up by large garbage trucks. In some areas recyclables also are picked up by trucks. In other areas, families are responsible for taking garbage to drop-off locations. Frequently, recyclables also are collected at these locations.

2. At the landfill, garbage goes into special lined areas that prevent the garbage from polluting surrounding land and water. Each day's garbage is buried and covered with a layer of soil.

## Student Activity Sheet

# Create a MINI-LANDFILL

This mini-landfill shows how garbage is layered and how landfills are designed to protect public health and the environment. Students may build their landfill individually or in groups. For each landfill:

1. Use a plastic cake container from the grocery store as your landfill site.

2. Cut eight circles from heavyweight paperboard (cereal boxes) or cardboard. Cut one circle from a black garbage bag. Students will use these circles to prepare representations of the many layers of a landfill.

3. Have students create the following.

   **A. Water Table** – Create a circle to represent the water table. Explain that the **water table** is the level below which the ground is saturated with water. Groundwater is the water below the Earth's surface that moves between soil particles and rock. This water supplies much of our drinking water. To make this layer, use crayons or markers to color the cut-out circle or – for a three-dimensional look – use clay or a salt and flour mixture colored with blue food coloring.

   **B. Dirt Layer** – This represents the ground. Have students color this layer or glue sand to the circle.

   **C. Plastic Liner** – Use a circle cut from a black plastic garbage bag and glue it to a cardboard circle to represent the thick plastic liner in the landfill.

   **D. Leachate Pipes** – Glue two straws together to represent the pipes that collect water in the bottom of the landfill. This water (leachate) is pumped from the landfill and treated at a wastewater treatment plant.

   **E. Trash Layer** – Have students glue a variety of trash to this circle.

   **F. Dirt Layer** – Prepare as before.

   **G. Trash Layer** – For this layer have students use only materials that can be recycled.

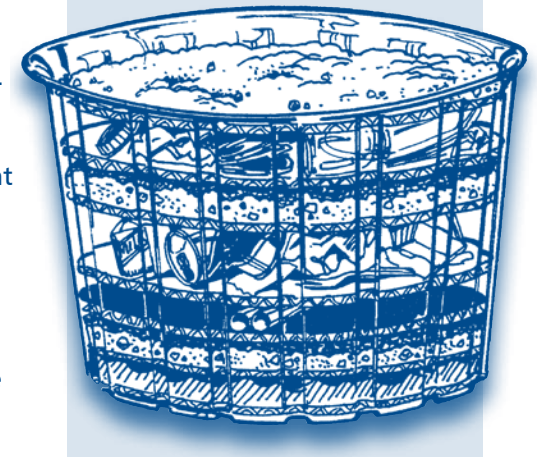
   **H. Dirt Layer** – Prepare as before. Explain to students that landfills are covered with a dirt layer at the end of each day.

4. After students prepare their landfills, have them discuss how garbage takes up space in the landfill. Then let students remove the recyclables from layer G. Let students see how keeping recyclables out of the landfill saves valuable space and resources. Explain that we must separate recyclable items from the garbage before it goes to the landfill.

## Supplies for Each Mini-landfill

- Plastic cake container
- Eight paperboard or cardboard circles cut to fit inside container
- Plastic circle cut from black garbage bag
- Small pieces of garbage including materials that can be recycled
- Glue, crayons and markers
- Two drinking straws
- **Optional:** Sand, salt and flour mixture, blue food coloring or clay

Landfills keep our garbage in place and help to protect the environment. Recycling helps save landfill space. When you remove from the waste stream the things that can be recycled, you reduce the amount of garbage disposed of in the landfill.



## Student Activity Sheet

# Create a Delicious LAYERED LANDFILL

*This activity simulates the construction of a landfill. Layers represent actual landfill components.*

**STEP 1:** Distribute supplies to each student. (The cup represents an excavated hole in the ground.)

**STEP 2:** Have students carefully "unscrew" two of their cookies so that one half has cream and the other half is bare. (Students should have two cookie halves with cream and two cookie halves without cream.) Crush the bare cookie halves into small pieces and put them into the cup. (The crushed cookies represent a layer of soil that is placed in the bottom of landfills.)

**STEP 3:** Next, have the students take the cookie halves with cream and break them into two or three pieces. Direct students to place the pieces in the cup with the cream side up. (These pieces represent a layer of clay that is put on top of the soil in landfills.)

**STEP 4:** Have students use the plastic knife to cut their fruit roll-ups into a circle roughly the same diameter as the top of the cup. Lay them flat on top of the cookies. (This represents the plastic liner which prevents leachate from flowing into the groundwater. **Leachate** is liquid that is created when garbage decomposes and rainwater runs through the landfill.)

**STEP 5:** Have students crush and add their graham crackers to represent a sand layer. (This layer is to protect the plastic liner.)

**STEP 6:** Next, have the students cut the licorice sticks in half and lay them on the sand layer. (This represents the leachate collection system which collects any liquid caught by the liner. In landfills, this system pumps leachate to holding ponds or tanks where it is treated.)

**STEP 7:** Have students place raisins on top of "licorice pipes" to represent a layer of pebbles. (This represents a cover for the leachate pipes and helps protect the liner.)

**STEP 8:** Have students sprinkle the candies or chips on top of the raisins. (These represent pieces of garbage.)

**STEP 9:** Next, add the scoop of chocolate pudding. (This represents the leachate created from decomposing garbage and rain seeping through the garbage.) Then have the students add one more layer of candies on top of the pudding. (Since garbage is placed in the landfill each day, liquid is continually created.)

**STEP 10:** Have students "unscrew" their two remaining cookies and crush another layer of the bare cookie halves on top of the candies and pudding to represent soil. (This layer reduces the amount of rain water that reaches the garbage.) NOTE: You will have two cookie halves with cream left over.

**STEP 11:** Add another layer of fruit roll-up. (This represents a final plastic liner to prevent rainwater from entering the landfill.)

**STEP 12:** Next, add a layer of whipped cream to "cap" or cover the landfill. (This represents the clay layer. It prevents odors, insect and rodent problems and repels rainwater.)

**STEP 13:** In front of the class, stick a candle deep into your (teacher's) "landfill" and light it. (This represents the methane gas recovery system which draws methane gas from the decomposing garbage. The flame represents energy that can be generated by burning the captured methane gas.)

**STEP 14:** Eat and enjoy your "landfill."

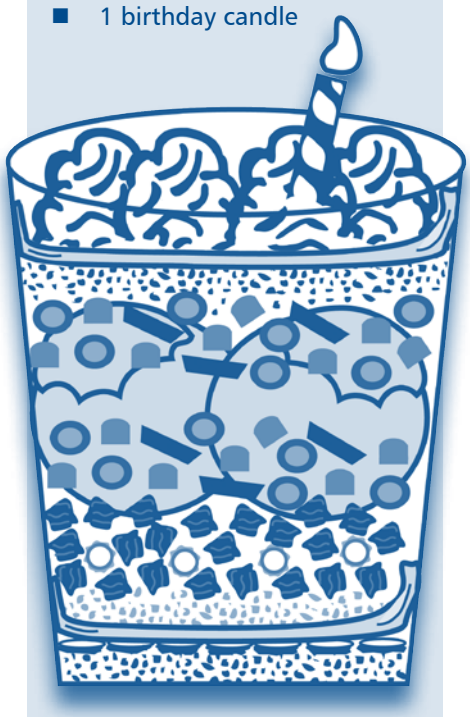
**STEP 15:** Finally, have students notice whether the cookies on the bottom are still dry or whether the pudding has passed through the fruit roll-up "liner" to soak the cookies. In a correctly built landfill, the cookies will be dry.

## Materials and Ingredients:

- 1 clear plastic cup (8 oz.) per student
- 4 Oreo cookies per student
- 1 plastic knife and spoon per student
- 2 fruit roll-ups per student
- 2 graham crackers per student
- 1 box of raisins (8 oz.) per student
- 2 licorice sticks per student
- 1 handful of a variety of small candies or chocolate/ peanut butter chips per student
- 1 scoop of chocolate pudding per student
- 2 Tbs. of whipped cream per student

**FOR THE TEACHER ONLY:**

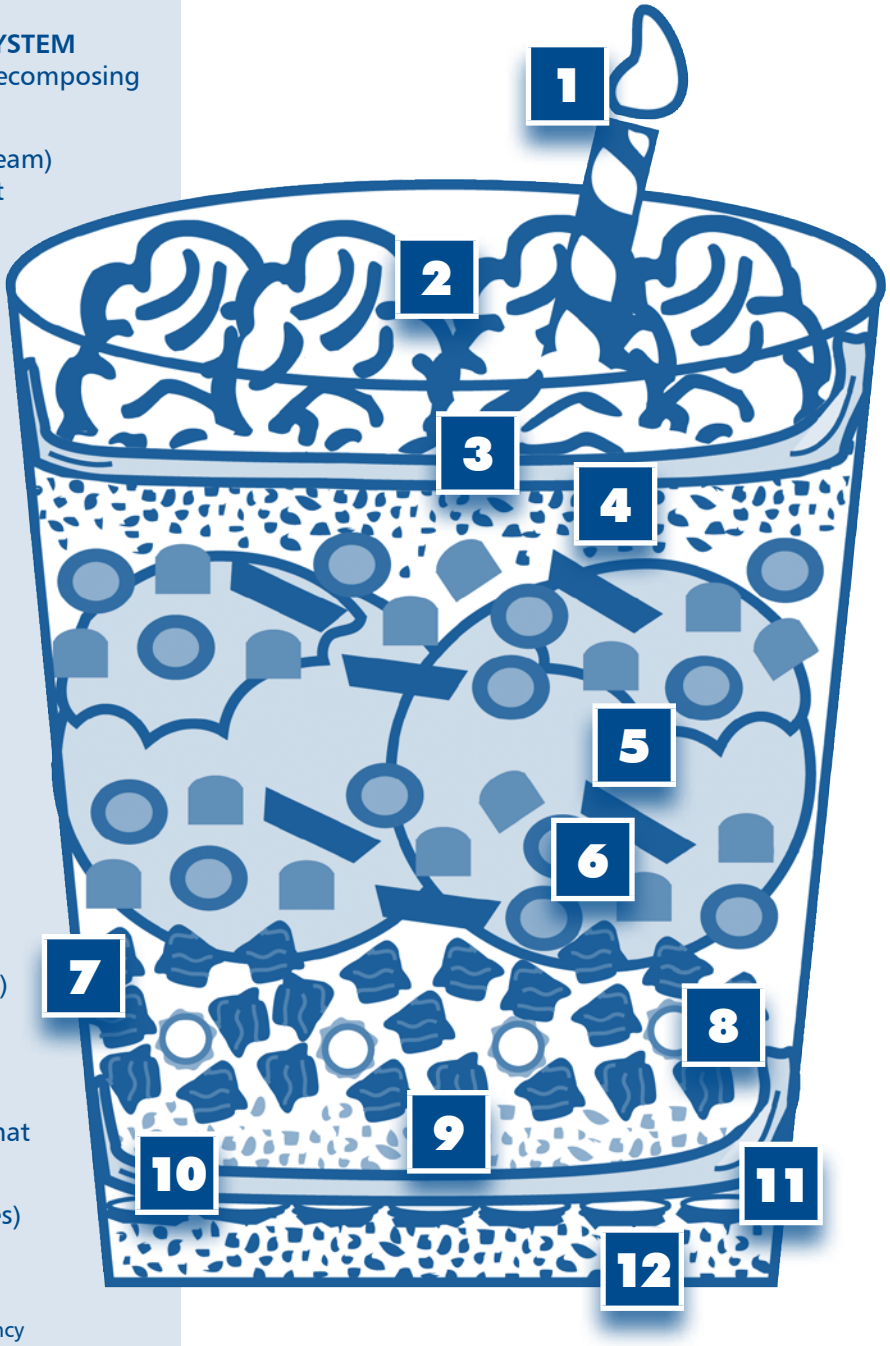
- Matches or a lighter
- 1 birthday candle



# ANATOMY OF A LANDFILL

1. A **METHANE GAS RECOVERY SYSTEM** (candle) recovers energy from decomposing garbage.
2. The **LANDFILL CAP** (whipped cream) prevents odor, insect and rodent problems and repels rainwater.
3. The **PLASTIC LINER** (fruit roll-up) prevents rainwater from entering the landfill.
4. The **SOIL LAYER** (cookie pieces) is used to cover garbage daily.
5. **LEACHATE** (pudding) is a natural by-product of decomposing garbage.
6. **GARBAGE** (candies) is added daily from communities.
7. The **PEBBLE LAYER** (raisins) helps protect the landfill's liner.
8. The **LEACHATE PIPES** or **COLLECTION SYSTEM** (licorice sticks) collect leachate.
9. The **SAND LAYER** (graham crackers) protects the landfill's liner.
10. The **PLASTIC LINER** (fruit roll-up) prevents leachate from flowing into groundwater.
11. The **CLAY LAYER** (cookie pieces) absorbs any leachate or liquid that escapes the plastic liner.
12. The **SOIL LAYER** (crushed cookies) lines the bottom of the landfill.

**SOURCE:** U.S. Environmental Protection Agency



# LIFE IN A FISH BOWL

**PREPARATION TIME: EXTENSIVE**

## Learning Objective

Students will:

- understand how water becomes polluted; and
- see the effect of water quality on living things.

## Background

When people think about **water pollution,** they probably imagine a big pipe coming out of the ground near an industry. The pollutants that come from a single, easily identified source such as the end of a pipe are called **point source water pollutants**.

But most water pollution comes from a more hidden form called **polluted runoff**. This type of pollution does not come from a single source like a pipe. Polluted runoff occurs when rainwater washes pollutants off of the land and into nearby water bodies. Another form of polluted runoff is when people pour pollutants directly into **storm drains**, thinking that this water then goes to the sewage treatment plant. Actually, anything passing through a storm drain goes directly into the nearest body of water.

To prevent polluted runoff, each of us needs to examine some of our habits. This lesson demonstrates how we cause polluted runoff and how we can make the necessary changes to prevent this type of water pollution.

## Learning Procedure

1. For this lesson, you will show what can happen to a fish when people pollute the water in which it lives. To demonstrate this, create a friendly fish character and have it live in a well-known nearby body of water. This could be a stream, lake, river or ocean.

2. If you don't have a fish bowl, you can make one from a pickle jar, clear 3-liter plastic bottle (cut off the tapered top) or similar container. Your fish can be made from any reusable water-proof item.

*Continued on the following page*

## Learning Essentials

**Focus:** The effect of pollution on wildlife

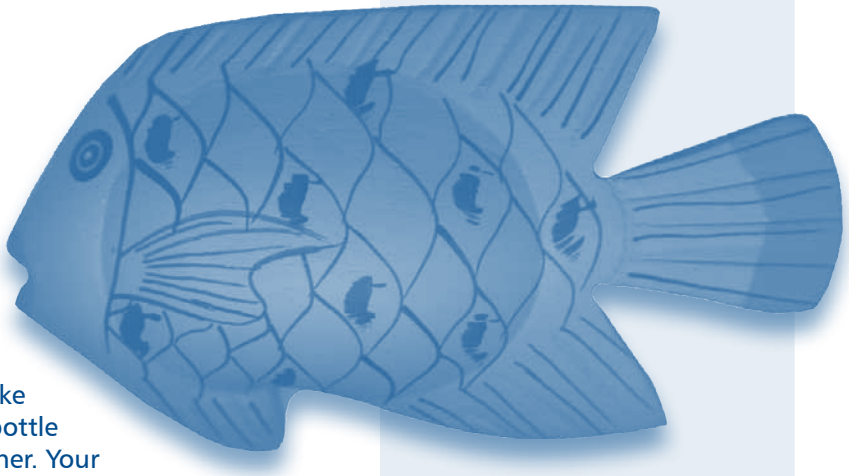
**Subject:** Science

**Extension:** Language Arts

**Materials:** Glass fish bowl or similar container (a clear, 3-liter plastic bottle works well), fish made from a Styrofoam meat tray or sponge, overhead projector or flashlight (optional but recommended), six separate containers each with 1/8 to 1/4 cup of the following: soil; soy sauce; liquid soap; blue sugar (made by adding a couple of drops of blue food coloring to sugar); cocoa powder; bits of trash (a cigarette butt is very effective)

**Teaching Time:** One class period

**Vocabulary:** Fertilizer, garbage, pesticides, point source water pollutants, polluted runoff, storm drains, water pollution



3. Put the Styrofoam fish on a stick or tape it to the inside or outside of your bowl. To see the effects of pollution on your pretend water body, put the bowl on an illuminated overhead projector or use a flashlight behind it. Remove a cup full of clear water to show the students the clean water in the beginning so you can compare it to the dirty water in the end. If you use a sponge for your fish, squeeze all of the dirty water out of it at the end of the lesson.

4. Read and adapt the Narrative. Ask individual students to add the ingredients in the containers as indicated to represent pollution.

## Narrative

Teachers should review the following Narrative in advance and adapt the language to the students' level. Also look for ways to personalize the story by including the name of your fish and the name of the water body.

1. **READ:** This is the story of _____ the fish. He lives in the water right here at ____. ____ loves living here. The clean water and sunshine make him healthy and playful.

   **ACTION:** Point to the fish in the clear water in the fishbowl.

   **ASK:** HOW DO YOU THINK _____ FEELS?

   This question should be asked repeatedly throughout the story and should generate an enthusiastic response from your students.

2. **READ:** There is one place on the land where some SOIL is washing into the water because someone has cleared the trees and bushes. These trees and bushes used to hold the soil in place. When ____ swims past this place, the soil in the water rubs against ____'s gills. This would be like getting soil in your lungs!

   **ACTION:** Have student pour soil from the container into the water.

   **ASK:** HOW DO YOU THINK_____ FEELS?

3. **READ:** ____ swims along through the creek. He passes through an area where someone has put too much **fertilizer** and **pesticides** on his lawn. It is raining and the extra fertilizer is washing into the water. The fertilizer has caused the algae in the water to grow too fast, making the water cloudy and using all of ____'s oxygen. ____ needs to breathe oxygen just like you and I do, and none is passing through his gills! The pesticides kill the aquatic insects that ____ needs to eat.

   **ACTION:** Add blue sugar to water.

   **ASK:** HOW DO YOU THINK ____ FEELS?

4. **READ:** ____ swims past a neighborhood that is near the creek. Some of the cars in the neighborhood are leaking oil onto their driveways. Because it is raining, the oil is washing off the driveway, down the street and into a storm drain. The storm drain carries the oil straight into the creek. This oil coats ____'s clean, shiny scales, and makes him greasy, dull and sick.

   **ACTION:** Add soy sauce to water.

   **ASK:** HOW DO YOU THINK ____ FEELS?

5. **READ:** As ____ heads away from the oil, he passes another neighborhood where many people are washing their cars and they are using a lot of soap. This soap is running out of their driveways, into the storm drain and coming right into the creek! This soap stings ____'s eyes and gills, and weakens his scales.

   **ACTION:** Add liquid dish detergent (stir briskly) to represent pollution from car washing.

   **ASK:** HOW DO YOU THINK ____ FEELS?

6. **READ:** Next ____ swims through a neighborhood where many people have dogs in their yards. When it rains, some of the DOG WASTE runs off the yards and into the creek. This waste pollutes the water because it contains germs that can make fish and people sick!

   **ACTION:** Add cocoa powder.

   **ASK:** HOW DO YOU THINK ____ FEELS?

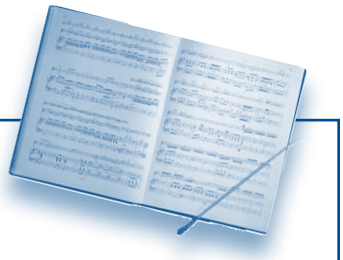
7. **READ:** Finally, ____ swims away from all of the polluted runoff. He can feel the water with its pollution behind him, but he knows that all of the things that made him feel so bad are flowing downstream with him. He swims quickly to get away from the dirty water, and OH NO! ____ runs into a piece of **garbage** that someone threw on the ground and then was washed into the water through the storm drain.

   **ACTION:** Add cigarette butt (or other garbage).

8. **ASK:** HOW DO YOU THINK ____ FEELS?

   **ACTION:** Hold up the cup of clear water you set aside at the very beginning.

   **ASK:** WHERE DO YOU THINK OUR FISH WOULD RATHER LIVE?



### Student Sing-Along

# THE DIRTY WATER BLUES

Pure water gurgles and splashes along until pollution flows into the song:

oil, tar, paint, dye, mud and muck
come splashing by.

Cans, jars, bottles, cars.

Old shoes, old news – that's the dirty water blues.

Sweet fresh water rolls away from this song,

while dirt and pollution keep flowing along
and along and along.

**SOURCE:** "Save The Earth! An Ecology Handbook for Kids"

## Questions for the Class

1. Have you ever seen a river, lake or beach closed for swimming?
2. Would you want to swim in a river like the one in our story?
3. Go back through the story, deciding ways that you can help solve some of these problems. (Examples: keep soil covered with plants to keep it from washing away, fix cars that leak oil and other fluids, use only the recommended amounts of yard chemicals if you use any at all, wash cars on the lawn or a commercial car wash where soapy water is sent to the sewage treatment plant, clean up after pets, don't litter.)

## Extension Activity

Read or improvise as a blues tune.

## Resources

- DHEC's Bureau of Water Web Site – **www.scdhec.gov/water**
- DHEC's Champions of the Environment – **www.scdhec.gov/champions**

MATH
HISTORY
SCIENCE

# OIL AND WATER

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- see how oil pollutes water;
- test water samples for oil residue; and
- perform an experiment to determine one part per 10 million.

## Background

Have you ever heard the saying "Oil and water don't mix?" It's true. Improperly disposed of oil can be a major threat to the environment, particularly our water supplies.

Most of us probably think that spills from oil tankers are the No. 1 source of oil dumped improperly into the environment. That's not the case. The U.S. Environmental Protection Agency (EPA) estimates that the largest single source of oil pollution harming our nation's waters is from people who change their own oil – **do-it-yourselfers** (DIYers). Overall, about 200 million gallons of used oil are disposed of improperly each year – poured down storm drains or the sewer, dumped on the ground or tossed in the trash – according to the EPA.

In South Carolina, **used motor oil** must be recycled – it's the law. The S.C. Solid Waste Policy and Management Act of 1991 (Act) prohibits the disposal of used motor oil in **Class 3 landfills**, sewers, drainage systems, septic tanks and surface water. The Act also prohibits using used motor oil on roads as dust control, for weed abatement and other uses that can potentially harm the environment. Used motor oil must be recycled. If you have your oil changed for you (at a car dealership or quick lube), your used motor oil is recycled by that business. If you are a DIYer, you must recycle the used motor oil.

South Carolina has one of the nation's best and most comprehensive recycling programs targeting DIYers. What began in the early 1990s to

*Continued on the following page*

## Learning Essentials

**Focus:** How oil pollutes water

**Subject:** Science

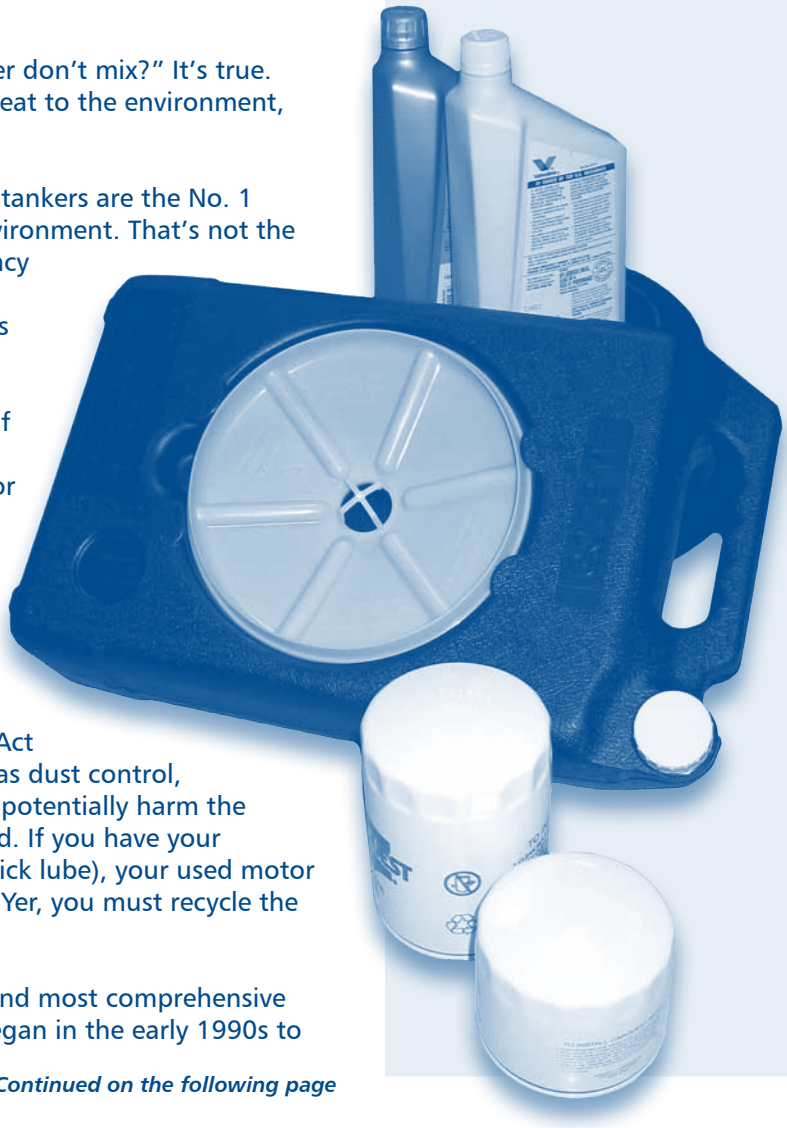
**Extension:** Social Studies

**Materials:** See list provided

**Teaching Time:** Two class periods

**Vocabulary:** Carcinogens, do-it-yourselfers, Class 3 landfills, oil, photosynthesis, plankton, used motor oil

**Lesson Resources:** "Used Motor Oil Recycling"



conserve resources and to stop illegal dumping of used motor oil, has grown into a one-stop program that also accepts motor oil bottles, filters and oil/gasoline mixtures from DIYers as well as used motor oil from small farming operations.

The program – primarily funded by DHEC through the Petroleum Fund – has grown to nearly 900 collection sites across the state. In addition, the program serves as a model of how convenience and participation go hand in hand. Part of this growth and subsequent success can be attributed to retail outlets, quick lubes and auto parts stores that accept used motor oil from DIYers. In calendar year 2010, DIYers recycled 984,437 gallons of used motor oil. Since 1990, DIYers in South Carolina have recycled about 17 million gallons of used motor oil. Used motor oil generated and recycled by DIYers is counted as part of the state's municipal solid waste (household garbage) recycling rate.

Just what does happen when oil ends up in water? When oil ends up in water, a film of oil on the surface can block **photosynthesis** and slow the production of oxygen. The reduced oxygen supply then causes stress to the point of death in aquatic organisms. Large organisms such as mammals and birds are the most familiar victims of oil pollution because of their visibility and emotional appeal to people. Feathers and fur stick together, become matted and lose the ability to insulate animals against cold. Death may result from temperature shock or from swallowing oil as the animals try to clean it from their coats.

Oil in water also can affect other organisms. Some of the components of oil may evaporate into the air or dissolve into the water. Many of them are **carcinogens**. Some of the oil spilled into an aquatic environment settles to the bottom affecting the organisms living there. Oil can clog breathing structures or be absorbed into tissues and then passed up the food chain, even to humans who eat fish or shellfish. Oil may harm bacteria or **plankton**, the basis of the food chain.

One gallon of used oil can potentially destroy 1 million gallons of fresh water – enough to supply 50 people with drinking water for an entire year. One pint of oil can produce a slick on water about 1 acre in size and will kill floating aquatic organisms.

It's not just the oil that poses a threat to the environment. As much as 20 percent of automotive oil is composed of substances that are added to improve performance, inhibit rust or prevent foaming – many of which are toxic. Oil also will pick up sediment and gasoline components and additives from the engine during combustion. High levels of lead – as well as other toxins including benzene, cadmium, zinc, magnesium and polychlorinated biphenyls (PCBs) – may be present in oil and may contaminate the environment if not properly handled.

Used motor oil should never be emptied into sewers or storm drains or dumped directly onto the ground to kill weeds or to suppress dust on dirt roads. Used motor oil also should never be thrown into the trash where it will end up in landfills. Improper disposal of used oil is illegal and carries penalties that include jail and fines of up to $10,000 per day.

## Why recycle oil?

It is clear that recycling used motor oil protects human health and the environment, but there are other reasons why we should recycle it.

- **Recycling used motor oil also saves valuable energy.** Two gallons of used motor oil can generate 36-kilowatt hours of electricity. That's enough to run an average household for a day, cook 36 meals in a microwave, blow dry your hair 216 times, vacuum your house for 15 months or run your television for 180 hours.

- **Recycling used motor oil also helps reduce dependency on foreign oil.** Oil is the No. 1 source of energy for the U.S., supplying about 40 percent of the nation's overall energy needs according to the American Petroleum Institute (API). About half of the oil we use is produced in the U.S while the rest is imported.

What happens to collected motor oil? It can be used in a variety of ways. Nationally, about 14 percent of the used motor oil collected is re-refined for use as a new generation of motor oil or as fuel oils according to the API. About 75 percent is reprocessed for use in asphalt plants, industrial and utility boilers, steel mills and other facilities. About 11 percent is used in specially designed space heaters in automotive bays and municipal garages.

The oil helps these types of facilities reduce their heating costs. This practice, however, is not recommended for home use. Most of the oil collected in South Carolina is burned for energy recovery to generate electricity.

## Lesson Materials

If possible, assemble several sets of these materials so that the class can perform the experiment in small groups. Otherwise use one set of materials and perform the experiment as a class.

One set of materials includes:

- seven test tubes (OPTIONAL: Seven same-sized jars, such as baby food jars);
- test tube rack;
- 10 ml graduated cylinder;
- olive oil;
- 250 ml beaker;
- brown paper bag (cut in strips);
- blue food coloring;
- wax pencil; and
- eye dropper (or calibrated straw).

## Learning Procedure: Day One

1. Review the background material with the class on the impact improperly disposed of used motor oil has on the environment, especially water.

2. Have students perform the following experiment to demonstrate how small quantities of oil can pollute large amounts of water. Perform the following experiment.

   A. Add a few drops of blue food coloring to a large bowl of water.

   B. Measure 100 ml of blue water from your bowl and place it into your 250 ml beaker.

   C. Add 9 ml of blue water to each test tube in your test tube rack.

   D. Calibrate the eyedropper to measure 1 ml. This can be done by adding 10 ml of this solution to your cylinder and then drawing out the water, using the eyedropper until the level in the cylinder reaches the 9 ml mark. Use the wax pencil to mark the water level in the dropper.

   E. Pour out unused water from your cylinder and measure out 1 ml of olive oil. Add this to test tube #1.

   F. Shake the test tube thoroughly. Quickly, before the oil and water separate, remove 1 ml of this solution with your calibrated dropper and add it to the next test tube (#2).

   G. Repeat step F until you feel that there is no oil left, checking either visually or by smell. Repeat step F no further than test tube #7. At this point, you will have a dilution of one 10-millionth.

   H. Check for oil in your solution by dipping a strip of brown paper 5 inches long by 1/2-inch wide into the test tube. If you don't observe the oil immediately, label your strip and set it aside to dry overnight.

   I. Clean the lab area and materials. Use warm water and soap to remove all traces of oil in all the test tubes.

## Learning Procedure: Day Two

1. Check the brown paper strips for oil spots.

2. Have students answer the "Questions for the Class" individually or as a group.

## Questions for the Class

1. Did you find oil spots on the brown paper strips the next day? (Yes)

2. Where do you think this oil would go in nature? (It may end up in lakes, rivers and groundwater. It may be swallowed by fish, animals and by people.)

3. What are some of the contaminants found in used oil? (Used oil contaminants include heavy metals such as lead, cadmium, zinc, barium, chemical additives, dirt, iron and steel particles.)

4. Did the water dilute the oil completely? (No)

5. List items you or your family own that use motor oil and have the capability of contaminating the environment. (This list may include lawn mowers, cars, boats, gasoline-powered tools such as chain saws, string trimmers and leaf blowers.)

6. What can you do with used motor oil to prevent it from becoming a source of pollution? (Take it to a used oil collection site. Visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE or call **1-800-768-7348** for the location nearest you.)

## Extension Activities

1. Have students prepare posters promoting used motor oil recycling and how to collect used motor oil for recycling. Ask local service stations and automotive parts stores to display them.

2. Have students investigate what your school district does with used motor oil, used motor oil filters and motor oil bottles from school buses and other maintenance equipment. Have students calculate how much used oil your school district must handle during the school year. (Calculate how many vehicles X how much oil per oil change X how many oil changes per year.)

3. Have students research and prepare reports on how used motor oil is used for energy recovery in South Carolina.

# THE RIVER FLOWS ALONG

**PREPARATION TIME: MODERATE**

## Learning Objectives

Students will:

- see how wastes from activities on land can pollute our water; and
- see how each person can help keep our water clean.

This is a role-playing and story-telling activity in which students act out the various activities that take place along a river. It works well for students to add costumes and props to enhance their roles. You may adapt the story and roles to waterways in your area.

## Background

When it rains, water washes across our land taking with it many different things that can **pollute** our water or make it dirty. Much of this **polluted runoff** can be prevented by people. In this simple activity, students act out life along a river and see how a few simple actions can help keep the river clean for everyone to enjoy.

## Learning Procedure

1. Have students select parts from the role-play and bring in costumes and props to support their parts.

2. Read the story as students step forward to act out their parts. After the story, have students discuss how to help keep our waters clean.

## Materials

The story "The River Flows Along," included with this lesson, is the basis for the role-play. Use costumes and props to simulate life along the river.

- **The River** – Several students are needed for this part to form a chain. Costume ideas include dressing students in blue, creating a large cardboard wave for students to carry, creating a sign that names the river, etc.

- **The Farmer** – Props may include a straw hat, overalls, hoe and fertilizer sack.

*Continued on the following page*

## Learning Essentials

**Focus:** How activities on land contribute to polluting our water

**Subject:** Science

**Extensions:** Social Studies, Health, Art

**Materials:** Various costumes and props (see the list provided)

**Teaching Time:** Several class periods

**Vocabulary:** Chemicals, fertilizer, litter, pollute, polluted runoff, soil

- **The Animals** – Several students can take this part. Props may include costumes or masks for cows, horses, pigs, straw, a sign that says, "Barnyard" or stuffed animals that the children hold.

- **The Construction Engineer** – Props may include a hard hat, rolled paper to look like blueprints, a toy dump truck, etc.

- **The Gardener** – Props may include a hat, flowers or a basket of vegetables, gardening gloves, a spray bottle or watering can, etc.

- **The City** – Props may include a toy building, a toy bus, signs and buildings made from cardboard.

- **The Picnic Children** – Several students can take this part. Props include a picnic basket with throw-away items such as paper plates and napkins that will serve as examples of **litter**.

- **The Homeowner** – Props may include a toy lawn mower, an apron, a cleaning brush and bucket, toy cars to wash, a bucket and sponge, a garden hose, etc.

- **The Swimmers** – Several students may take this part. Props may include bathing suits, floats, beach towels, etc.

## Narrative: The River Flows Along

Once upon a time, there was a gently flowing river, the _____ (name your river). And like all rivers, the _____ (your river) rippled with cool, clean, fresh water as it flowed down from the South Carolina mountains.

Many kinds of fish (name local fish found in your area) called the river home and many small animals drank from the water as it passed on its way downstream.

At a bend in the river, it passed a farmer's green fields. The farmer fertilized his fields to help the crops grow tall, but when it rained some of this **fertilizer** ran off the fields and down into the river. And while this fertilizer helps plants grow on land, it can be harmful if too much runs off. "Please be careful," cried the river to the farmer. "What goes on the ground can flow into my water when it rains."

Just beyond the fields, the river passed the farmer's barnyard. The animals love to drink at the water's edge and rest by the gently flowing water. But when too many animals gather at the water's edge, the water can get dirty. "Please be careful," cried the river to the animals. "What goes on the ground can flow into my water when it rains."

The river flowed from the countryside to a place where office buildings and parking lots were being built beside the water. While the river welcomed people to enjoy the water, it worried as the construction engineers cut trees and scraped away the grass from its banks. When it rained, **soil** from the bare land ran into the river and turned the blue waters muddy. "Please be careful," cried the river to the engineers. "What goes on the ground can flow into my water when it rains."

As the river widened it passed more buildings until an entire city sat on its banks. The city was exciting with many cars and people rushing here and there. There was so much for the river to see, but there also was so much from the city that ran into the river. Each time it rained, the water washed over the city buildings and streets and carried dirt into the river. "Please be careful," cried the river to the people. "What goes on the ground can flow into my water when it rains."

At a city park, many children came to picnic. And while the river loved seeing them play and hearing their laughter, it was sad when the children left litter behind that would blow into its water. "Please be careful," cried the river to the children. "What goes on the ground can flow into my water when it rains."

Past the city, the river narrowed again as it flowed past several housing developments where many families lived. The river was a fun gathering place for everyone. But the river didn't enjoy it when the homeowners would let oil and grease, dirty car wash water, pesticides, pet waste, and harmful household **chemicals** wash off and run down to the river. "Please be careful," cried the river to the homeowners. "What goes on the ground can flow into my water when it rains."

And the river just couldn't understand why all the people along its banks weren't more careful. After all, they all wanted to fish and drink from the river and swim in the river. The river wished that everyone would remember "Please be careful. What goes on the ground can flow into my water when it rains."

## Extension Activities

1. Have students create a classroom mural of their river from "The River Flows Along." Each student can create a panel that shows one type of activity along the river (from the story or their own idea). Have each student color the bottom third of the paper blue to represent the river. This way the river can flow from panel to panel when you connect all the panels to make your mural. As you assemble the mural, let each student describe the activity drawn and ideas about how to safeguard the river from pollution.

2. **Ask:** Can we see what's in our river? Students may say that even though they know that there is activity along a river, they have never seen the pollution in a river. In this activity, students discover that just because we can't see things in our water doesn't mean that they aren't there.

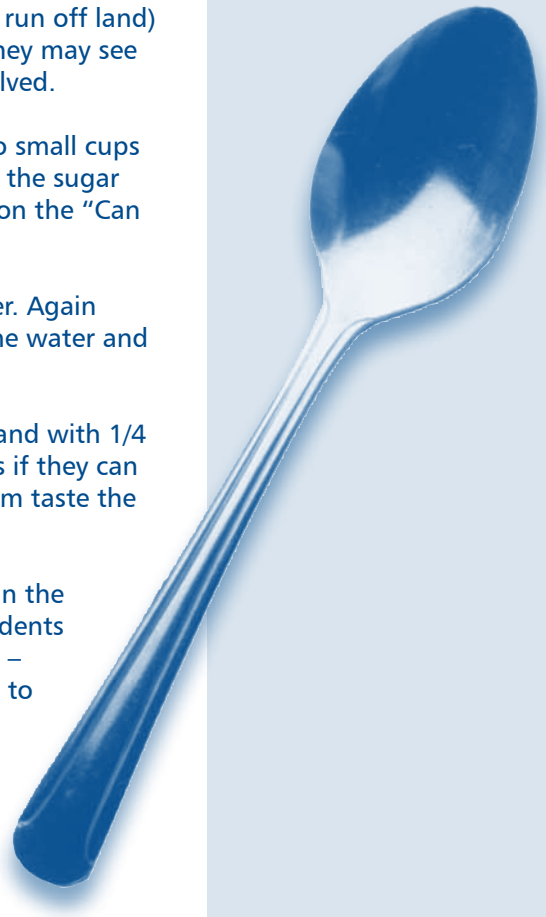
   **Ask:** Can we see pollution in our waterways? Discuss with students that some things such as litter and oil can be seen but that many other things such as chemicals can't be seen in our water.

   - Mix 1/4 cup sugar (representing a chemical that has run off land) with 1 cup of water. Ask students what they see – they may see some of the sugar granules. Keep stirring until dissolved.
   - Pour a small amount of the sugar water mixture into small cups for each student to taste. Ask them if they can taste the sugar that they saw. Have them record their observations on the "Can You See What's in the Water" Student Worksheet.
   - Repeat the test with 1/4 cup sugar in 2 cups of water. Again have students observe if they can see the sugar in the water and if they can taste it.
   - Repeat the test with 1/4 cup sugar in 3 cups water, and with 1/4 cup sugar in 4 cups of water. Each time ask students if they can see what you added to the water and then have them taste the water and say if they can taste the sugar.

   Students should conclude that they can't see the sugar in the 4 cups of water but that they can taste it. Explain to students that this is how it is with many forms of water pollution – we can't always see it but it is still present. Ask students to name some chemicals that could end up in water that they couldn't see but that could cause harm (e.g., bleach, some pesticides and fertilizers, ammonia, etc.).

## Materials for the Extension Activity

- Sugar (1 cup)
- Water
- A clear container such as a clear 2-liter plastic bottle
- Measuring cup
- Small, clear drinking cups
- Spoon for stirring
- "Can You See What's in the Water" Student Worksheet



**Student Worksheet** Name: _____

# CAN YOU SEE WHAT'S IN THE WATER?

| SUGAR | WATER | WHAT I SEE | WHAT I TASTE |
|---|---|---|---|
| 1/4 cup | 1 cup | | |
| 1/4 cup | 2 cups | | |
| 1/4 cup | 3 cups | | |
| 1/4 cup | 4 cups | | |

**Student Worksheet** Name: _____

# CAN YOU SEE WHAT'S IN THE WATER?

| SUGAR | WATER | WHAT I SEE | WHAT I TASTE |
|---|---|---|---|
| 1/4 cup | 1 cup | | |
| 1/4 cup | 2 cups | | |
| 1/4 cup | 3 cups | | |
| 1/4 cup | 4 cups | | |

# RUNOFF RACE

**PREPARATION TIME:** **MODERATE**

## Learning Objectives

Students will:

- see how rain water moves across our land;
- see how plants help keep this runoff from entering our waters; and
- understand the role wetlands play as a buffer between dry land and waterways.

## Background

When it rains, water flows across the land carrying with it **waste** that can pollute our water and threaten the many living resources that depend upon clean water. Some **pollutants** come from our farms and fields (e.g., animal waste, **fertilizers, pesticides**), our city streets (e.g., motor oil, pesticides, **litter**) and our own backyards (e.g., harmful household chemicals, fertilizers, pesticides, pet waste). Pollutants enter **waterways** via rain, **runoff** and **groundwater** or are dumped directly into the water. Once in the water, they are carried along with the flow of water and are difficult to remove.

One way to stop this waste from polluting our water is to be very careful about what we discard and very careful about how we use our land and alter our landscape.

**Wetlands** – plant areas that are between land and water – are helpful in keeping soil in place and slowing runoff that may contain waste that can contaminate our water. Wetlands often are the last stopping place for runoff before it enters water. Wetland plants slow the flow of water enough to allow time for the heavier particles to settle. Smaller particles will be trapped in the mesh of leaves, stems and roots created by densely vegetated wetlands. Fine silt particles often are found on wetland plants meaning that the water flowed on without them.

## Materials for Demonstration 1

- Clear quart container with lid
- Small pebbles, sand, dirt, crushed leaves
- Water

*Continued on the following page*

## Learning Essentials

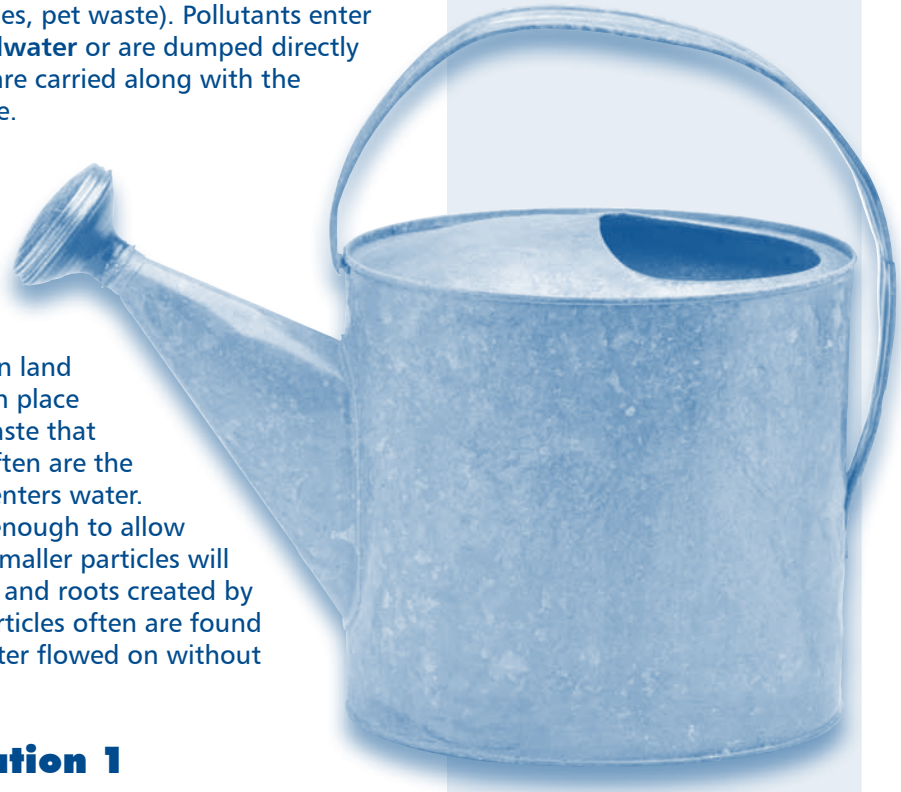
**Focus:** How water becomes polluted

**Subject:** Science

**Materials:** See the list of materials provided

**Teaching Time:** 45 minutes

**Vocabulary:** Fertilizers, groundwater, litter, pesticides, pollutants, runoff, waste, waterways, wetlands



## Materials for Demonstration 2

- Two flat pans or boards (no lip)
- Two shallow pans with low sides
- A piece of sod, artificial turf mat or other very textured material (like a door mat)
- A way to adhere grassy material to pan
- Two equal containers of water
- Something to prop up pans (books)
- Illustration A (provided) for reference

## Learning Procedure

**NOTE:** This may be done in groups or as a demonstration. For best results, practice with your materials before class. There are two demonstrations in this activity.

1. **Ask:** What happens to the rain when it falls? Where does it go? Explain how the rain flows across everything – our houses and yards, buildings and streets, farms and fields, etc. Discuss how the rain picks up dirt and other things and carries them along. Ask students what types of things the rain can carry – dust and dirt, oil from the road, leaves and twigs, litter, fertilizer and chemicals from fields, etc.

   Ask students if they have ever seen a fast-flowing stream or river. Explain that the faster the flow of water, the more dirt and other things it can carry with it and that too much of this can pollute our water and damage the environment.

2. **Demonstration 1:** Mix different sediments (sand, dirt, etc.) together in the clear container, filling half the container. Top off the container with water and put on the lid. Have a student shake the container until thoroughly mixed and set the container where all students can see it.

   As the class watches the sediments settle, explain that muddy water can be harmful to wildlife. Ask students if they can think of reasons why. (Muddy water clogs fish gills, smothers fish eggs, blocks sunlight and affects aquatic plant growth, etc.)

   **Ask:** Would more sediments settle to the bottom if the water was flowing quickly or slowly? (Slowly. Slower flow means smaller particles settle and do not flow with the water.)

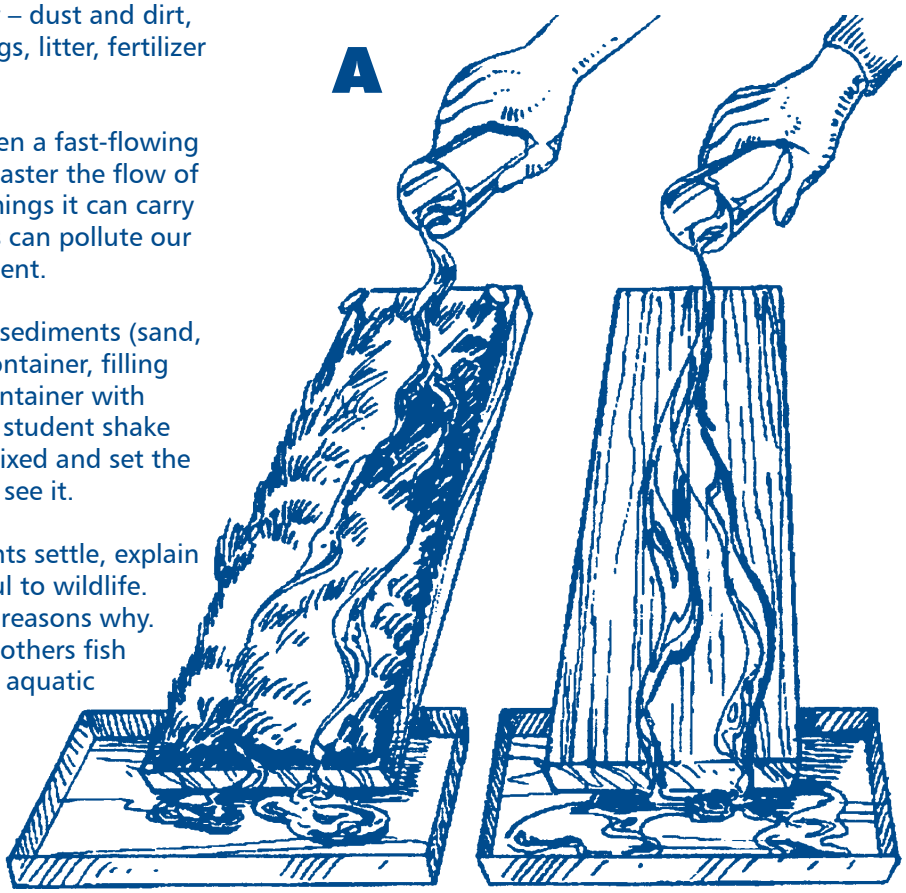
   Describe how the particles are settling in the jar in layers – the largest or heaviest first. Fine or light particles may not settle at all. Small pieces of leaves, twigs and bark may float on the surface.

   Describe how plants and wetlands can slow the flow of water by simply being in the way.

3. **Demonstration 2:** Show students the model and explain how the slick model represents bare ground and that the green side (with a door mat or grass covering) represents a healthy wetland with plants. In both, rain falls and flows down toward a lake (the pans at the end).

   Have students participate by pouring rain from a container or watering can onto the top end of both models at the same time. See the illustration below.

   **Ask:** In which model does the water flow fastest? (The bare one without the healthy plants.)



In which area – wetland or bare ground – would more particles or sediments settle? (The healthy wetland will cause more dirt to settle and will keep more particles or pollution out of our water.)

Which one would have cleaner water flowing from it? (The healthy wetland.)

How would digging a ditch through a wetland affect water quality downstream? (Digging a ditch through a wetland would create a path for water to flow through quickly, without passing through the wetland plants. This would mean that the filtering action of the wetland would be diminished and the water quality downstream would be lessened.)

4. Discuss why someone might dig a path through a wetland area. (Usually digging is done to drain a wetland to make the land more useful for farming or building.)

   Why is it important to preserve wetland areas? (Wetlands help keep our water supply clean.)

## Extension Activity: Wetland in a Pan

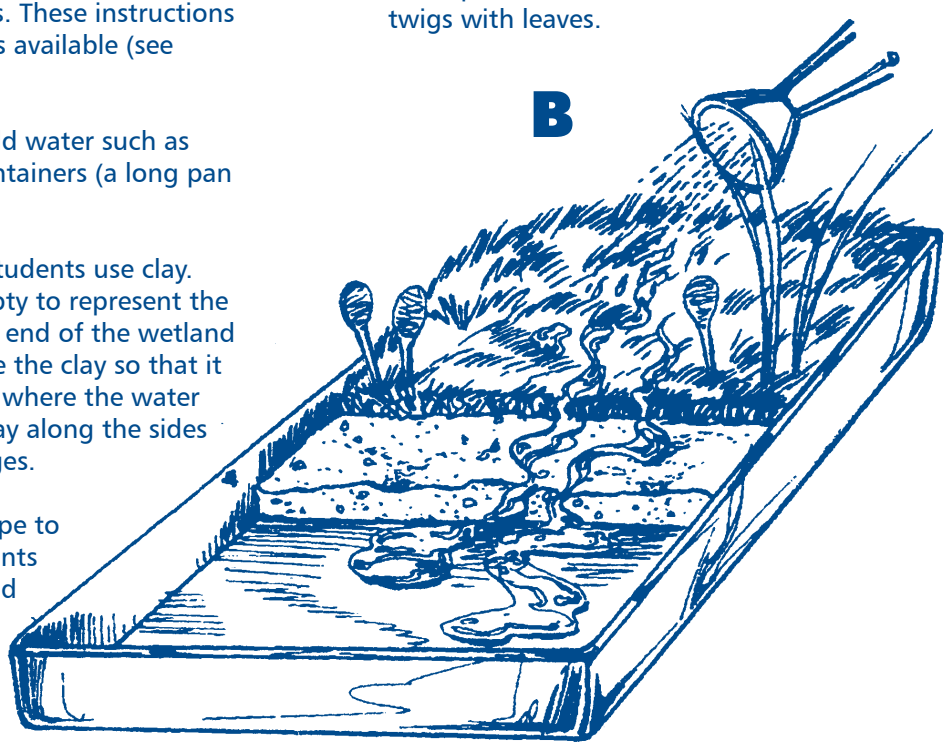
1. Have students make their own wetland models individually or in small groups. These instructions may be modified for materials available (see Illustration B).

   - Use any pans that will hold water such as baking pans or plastic containers (a long pan works best).
   - To build the slope, have students use clay. Leave half of the pan empty to represent the lake, river or ocean at the end of the wetland area. Have students shape the clay so that it gradually slopes down to where the water will begin. Smooth the clay along the sides of the pan to seal the edges.
   - Use a covering for the slope to represent the wetland plants or buffer between the land and water. This covering may be a piece of old carpeting, felt, towel, real turf or any type of textured matting. Be sure that the covering fits well. The model won't work if there are spaces under the wetland surface or down the sides of the pan.

2. Have students review the features of their wetlands. Explain that wetlands – like all habitats – are complicated natural systems. Wetlands perform some very important functions such as filtering pollutants, reducing flood damage and preventing soil erosion. Have students rain on their wetlands and observe how the plant area (the carpet or matting) slows the flow of water.

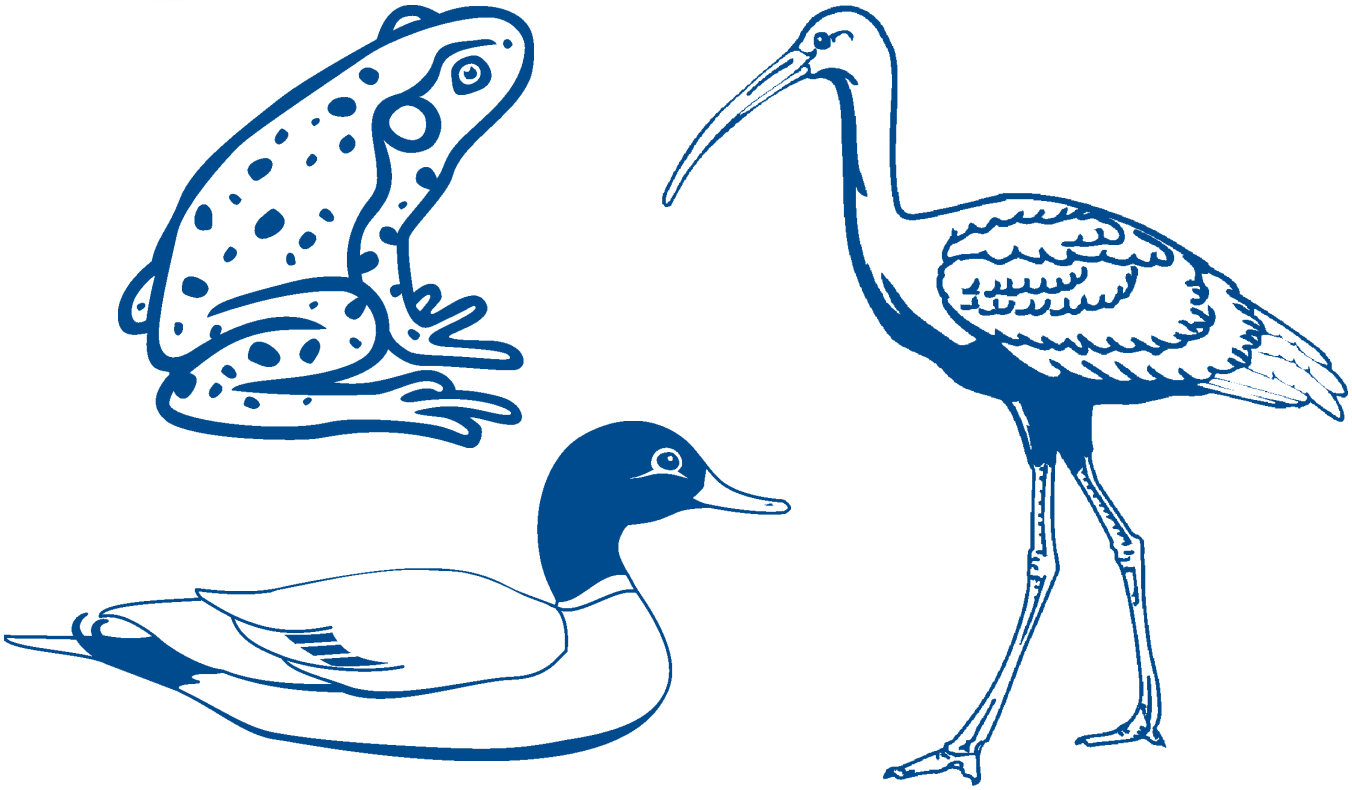
3. Have students add wetland features to their models. See Illustration B for ideas. Students can make fresh water or salt marsh models. Here are some ideas:

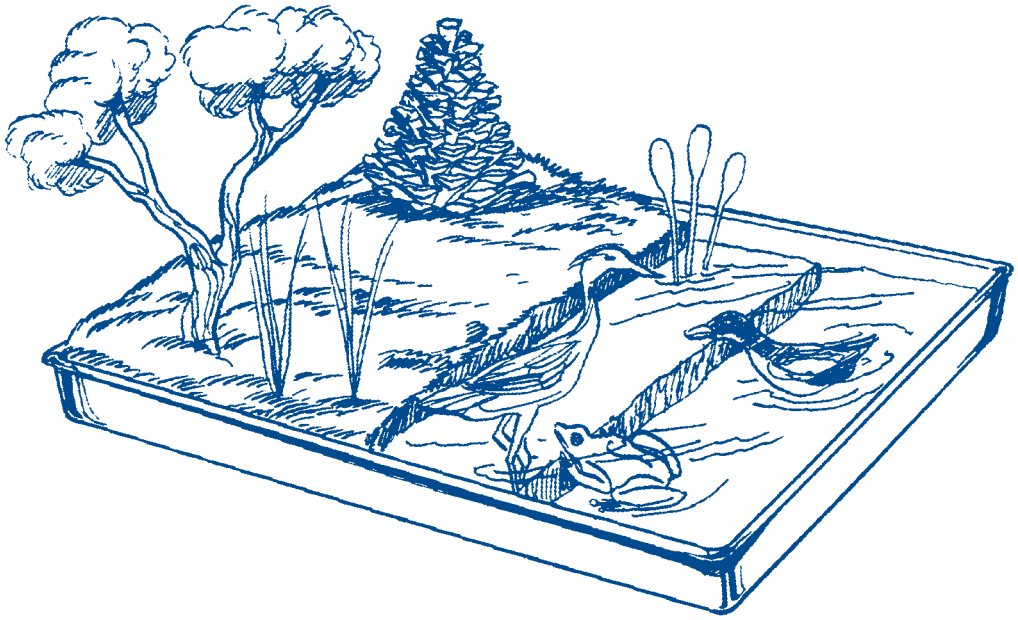
   - Use cotton swabs for cattails. Students can paint the stems green and tops brown.
   - Use pine needles for reeds.
   - Make wetland creatures. Students can use the illustrations on the "Wetland in a Pan" Student Handout (included with this lesson) or can make their own. Tape them to toothpicks.
   - Small pine cones make nice trees or use small twigs with leaves.



Student Handout

# WETLAND IN A PAN





# TAKING THE SWAMP OUT OF SWAMP WATER

| PREPARATION TIME: | EXTENSIVE |
|---|---|

## Learning Objectives

Students will:

- discuss ways to clean water;
- predict which filter will do the best job;
- observe experimental results;
- form conclusions based on experimental results; and
- use experimental results to decide on additional experimentation.

## Background

Fresh water can be found in three main places on Earth: **surface water**; **groundwater**; and frozen as snow and ice. All of these **source waters** can be used for drinking water.

Before the water comes out of the faucet in your home, it needs to be made safe to drink. Public drinking water must meet the standards set by federal and state governments. The cleaning of water is done at a water treatment plant. The water treatment plant uses two basic steps to clean and purify water for drinking. Step one is to **filter** the water to remove dirt and other particles and the second step is to disinfect it. Some organisms that can cause waterborne illness are so small that they can pass right through filters.

## Learning Procedure

1. Discuss the background material about drinking water and where source water comes from in your area (Is it groundwater or surface water?). Ask the students if they would drink water right out of a lake or stream. Why not?

2. Discuss the purpose of a water treatment plant. Review the two jobs of a water treatment plant. Remember, these facilities:

   - clean water with filters; and
   - disinfect the water with chemicals and prepare it for drinking.

3. Tell students that they are going to test several water filters. Prepare the water filters by cutting the bottom off of a 20-ounce plastic soft

*Continued on the following page*

## Learning Essentials

**Focus:** Using filters to clean water

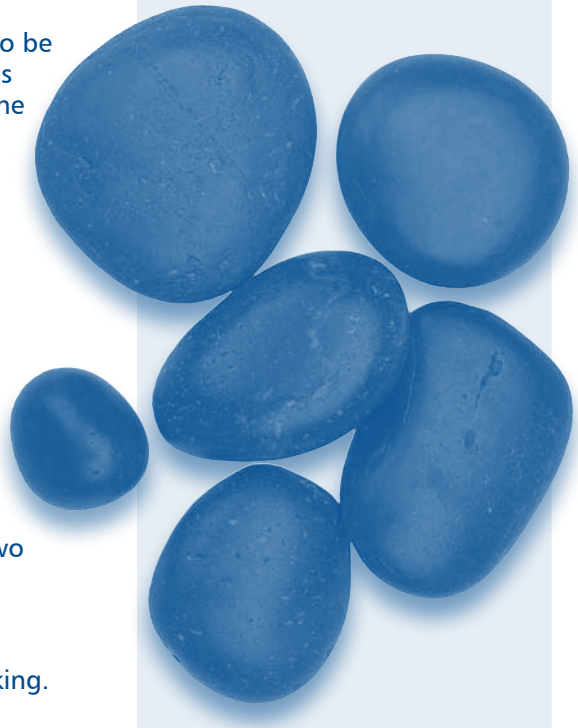
**Subject:** Science

**Extension:** Health

**Materials:** Four 20-ounce plastic soft drink bottles, coffee filters, sand, assorted small rocks, cotton balls (pulled apart), nylon stocking, clear jug filled with muddy water

**Teaching Time:** One class period

**Vocabulary:** Filter, groundwater, source waters, surface water



drink bottle to form a funnel shape (see the illustration below). Place the funnel (neck down) into the cylinder to form a complete filter. DO NOT ALLOW STUDENTS TO CUT OUT THE BOTTLES. This should be done by the teacher.

4. Prepare a set of four different filters for each team:

   - **Filter 1:** Place a piece of nylon stocking on the smallest end of the funnel and secure it with a rubber band. Place cotton balls in the funnel to fill it to within 1 inch of the top. Pack the cotton balls down well.

   - **Filter 2:** Place a piece of nylon stocking on the smallest end of the funnel and secure it with a rubber band. Place two coffee filters in the funnel. Place them so as to prevent any water poured into the filter from passing between the coffee filter and the wall of the funnel.

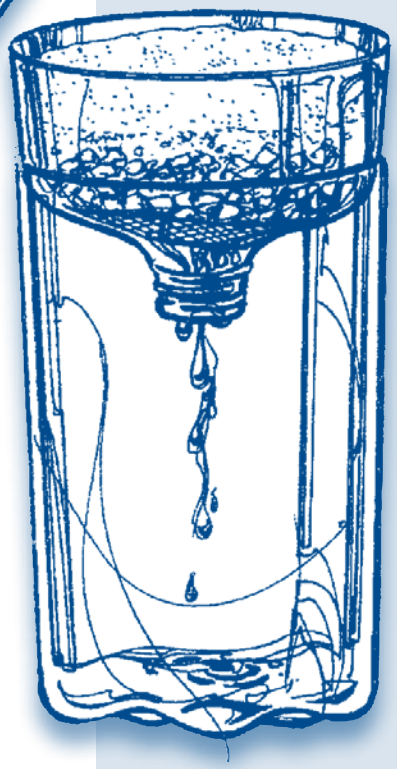
   - **Filter 3:** Place a piece of nylon stocking on the smallest end of the funnel and secure it with a rubber band. Place small rocks into the funnel. Fill it to within 1 inch of the top.

   - **Filter 4:** Place a piece of nylon stocking on the smallest end of the funnel and secure it with a rubber band. Fill the funnel with sand to within 1 inch of the top.

5. Line up the four types of filters on a table. Ask the students to predict which filter they think will work best. Why?

6. Shake the jug of muddy water. Pass it around the class. Have each team pour some muddy water through each type of filter and observe what happens. Record your observations.

7. Have students report their results to the class and compare results. Which type of filter worked best? Why? What types of filters do water treatment plants use?



## Extension Activity

Have the students design their own filters using the soft drink bottle setup. How would the teams design the best filters for cleaning water? What about using a combination of materials?

IMPORTANT: Tell the students that even though the filtered water looks clean, IT IS STILL NOT FIT TO DRINK and must be chemically treated to kill germs.

# WE ALL LIVE DOWNSTREAM

**PREPARATION TIME:** **MODERATE**

## Learning Objective

Students will see how we all share in the responsibility to keep our rivers and other waterways clean.

## Background

When it rains, water washes across our land taking with it many different things that can **pollute** our water. This water is called **runoff**. The good thing is runoff pollution can be prevented by people.

The culmination of individual actions can have positive or negative results. Students will see evidence of this when working on group projects. When they work together and cooperate, the results are usually successful. If one or more of the group members do work of poor quality, however, it will affect the outcome. In this activity, students also will see that when they look at a polluted river or stream, they are looking at the sum of individual actions. When a stream has been cleaned or is kept clean, again they will see the results of individual actions.

The quality of water in a river or lake is, to a large extent, a reflection of land uses and natural factors found in a river's **watershed**. If soil near a river or lake **erodes**, chances are the river has **sediment** problems and is not clear. If the land has stable cover – such as plants – erosion can be limited.

When people develop land, water quality can be affected. Breaking sod, cutting forests, building homes, mining and other land uses contribute to water quality problems. Everyone is responsible for the health of a watershed and water systems (rivers, lakes, wetlands, etc.). Individual actions – both positive or negative – add up.

## Learning Procedure

1. Have each student bring in a large piece of posterboard. Number the posters in sequential order, placing numbers in the upper left-hand corner. Using a blue marker/crayon, have students draw and color a river on their poster. Have half the class draw their river along the top fourth of their posters and the other half draw their river along the bottom fourth of their posters. (This way, when students put their pieces

*Continued on the following page*

## Learning Essentials

**Focus:** Awareness of watersheds and who uses water along the way

**Subject:** Science

**Extensions:** Social Studies, Art

**Materials:** Several large sheets of posterboard, scissors, masking tape, crayons or markers (including blue)

**Teaching Time:** Several class periods

**Vocabulary:** Erodes, nonpoint source pollution, pollute, runoff, sediment, watershed

of the river together to make a single river, you'll have a north and south bank.)

2. Tell students that they have each inherited a piece of waterfront property and $1 million. Have students list ways people use waterfront property and waterways.

3. Explain that the blue on their poster is water and the blank space is land they own. Each student has $1 million to develop their land as they wish. They can build resorts, homes, hotels, factories, parks, farms, golf courses, marinas, etc. – whatever they like. (You may allow them to take these home or give them time to draw in class.)

4. When students have completed their drawings, ask them to look in the upper left-hand corner of their property for a number. Explain that the pieces are actually parts of a puzzle. Starting with No. 1, have them add their pieces, putting the stream together, where everyone can see it. Use masking tape to hold pieces together. (You'll need a long wall to display the artwork. The blackboard or a hallway wall works well.)

5. Have students describe what they did to their land. Determine if their actions could pollute or add materials to the waterway. Tell the students that the water in their river flows from left to right. As the river flows from property to property, have students discuss how water quality could suffer.

6. When students complete their river, have them select an item or items from their desk (e.g., book, piece of paper, pen, pencil, etc.) to represent each source of pollution their property add to the river. Tell students to take their article(s) and line up in the same order as their pieces of waterfront property. Have the students pass their pieces of pollution downstream in the same way pollution travels. The first student will pass his/her article(s) to the second student, the second student will pass the items to the third and so on until the last student is trying to hold all the pieces. Have each student announce the type of pollutant they are holding before they pass it downstream. (For example, a marina might identify litter and oil pollution from motor boats.)

7. When all the articles have reached the end, discuss the activity. How did students in the middle and at the end of the river feel? What about their property development plans? Could businesses downstream be affected by the actions of one upstream? Could upstream users alter the water quality of those downstream? (Discuss water quality for swimming, fishing, drinking water supplies and shellfish harvesting.)

8. Tell students to reclaim the items they used to represent pollutants from their property. Explain that the items they can easily identify as their own are called "point source" pollution. That's because we know the source and can point to it. Other items representing pollution (pencils, paper clips, paper) may be difficult to reclaim because the pollutant originated from multiple sources. Tell students this represents **nonpoint source pollution** (runoff pollution).

9. Ask students what they need to do so that everyone can use the waterway and still maintain water quality. (They may decide it is necessary to regulate what people can do with their land.)

10. As a follow-up activity, have each student write one paragraph about what he/she would do to reduce or stop polluting.

## Question for the Class

How do the activities of individual water users contribute to water quality?

## Teacher's Resource

# LESSON CORRELATIONS

**K-2.1** Recognize what organisms need to stay alive (including air, water, food and shelter).

**Taxonomy Level:** 1.1A/Remember Factual Knowledge

- Air, Air is Everywhere!
- Life in a Fish Bowl
- This is the Way We Use Our Air

**K-2.2** Identify examples of organisms and nonliving things.

**Taxonomy Level:** 1.1A/Remember Factual Knowledge

- Natural or Man-made?

**K-5.2** Compare the properties of different types of materials (including wood, plastic, metal, cloth and paper) from which objects are made.

**Taxonomy Level:** 2.6B/ Understand Conceptual Knowledge

- Natural or Man-made?
- Recycle It!

**1-2.1** Recall the basic needs of plants (including air, water, nutrients, space and light) for energy and growth.

**Taxonomy Level:** 1.2A/Remember Factual Knowledge

- Air, Air Is Everywhere!
- Life in a Fish Bowl
- This is the Way We Use Our Air

**1-2.5** Explain how distinct environments throughout the world support the life of different types of plants.

**Taxonomy Level:** 2.7B/Understand Conceptual Knowledge

- A Rotten Idea

**1-4.1** Recognize the composition of Earth (including rocks, sand, soil and water).

**Taxonomy Level:** 1.1A/ Remember Factual Knowledge

- A Rotten Idea

**1-4.6** Exemplify Earth materials that are used for building structures or for growing plants.

**Taxonomy Level:** 2.2A/Understand Factual Knowledge

- Natural or Man-made?

**2-2.1** Recall the basic needs of animals (including air, water, food and shelter) for energy, growth and protection.

**Taxonomy Level:** 1.2A/Remember Factual Knowledge

- Garbage Snooping

**2-4.4** Recognize that different materials can be mixed together and then separated again.

**Taxonomy Level:** 1.1A/Remember Factual Knowledge

- Crayon Trash Stash
- My Bag

**3-1.3** Generate questions such as "what if?" or "how?" about objects, organisms and events in the environment and use those questions to conduct a simple scientific investigation.

**Taxonomy Level:** 6.1-B and 3.2-B Create and Apply Conceptual Knowledge

- Recycling: A Valuable Lesson

**3-1.7** Explain why similar investigations might produce different results.

**Taxonomy Level:** 6.1-B and 3.2-B Create and Apply Conceptual Knowledge

- Recycling: A Valuable Lesson

**3-2.1** Illustrate the life cycles of seed plants and various animals and summarize how they grow and are adapted to conditions within their habitats.

**Taxonomy Level:** 2.2-B Understand Conceptual Knowledge

- Recycle It!

**3-3** The student will demonstrate an understanding of Earth's composition and the changes that occur to the features of Earth's surface. (Earth Science)

- Runoff Race

**3-3.2** Identify common minerals on the basis of their properties by using a minerals identification key.

**Taxonomy Level:** 1.1-A, B Understand Factual and Conceptual Knowledge

- Musical Resources

**3-3.5** Illustrate Earth's saltwater and freshwater features (including oceans, seas, rivers, lakes, ponds, streams and glaciers).

**Taxonomy Level:** 2.2-A Understand Factual Knowledge

- The River Flows Along

**3-4** The student will demonstrate an understanding of the changes in matter that are caused by heat.

- Crayon Trash Stash

**4-2.3** Explain how humans and other animals use their senses and sensory organs to detect signals from the environment and how their behaviors are influenced by these signals.

**Taxonomy Level:** 2.7-B Understand Conceptual Knowledge

- Recycle – Don't Litter

**4-2.5** Explain how an organism's patterns of behavior are related to its environment (including the kinds and the number of other organisms present, the availability of food, and other resources, and the physical characteristics of the environment).

**Taxonomy Level:** 2.7-B Understand Conceptual Knowledge

- Recycle – Don't Litter

**4-4** The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

- We All Live Downstream

**4-4.3** Compare daily and seasonal changes in weather conditions (including wind speed and direction, precipitation, and temperature) and patterns.

**Taxonomy Level:** 2.6-B Understand Conceptual Knowledge

- Today's Forecast

**5-3** The student will demonstrate an understanding of features, processes and changes in Earth's land and oceans. (Earth Science)

- Runoff Race
- The River Flows Along

**5-3.6** Explain how human activity (including conservation efforts and pollution) has affected the land and the oceans of Earth.

**Taxonomy Level:** 2-B Understand Conceptual Knowledge

- Give Burn Barrels the Boot
- Hazardous Household Waste
- Look in Your Garbage Can
- Musical Resources
- My Bag
- Recycle – Don't Litter
- Recycling: A Valuable Lesson
- We All Live Downstream
- Where Does Garbage Go?

**5-4** The student will demonstrate an understanding of properties of matter. (Physical Science)

- Stick'em Up

**5-4.8** Explain how the mixing and dissolving of foreign substances is related to the pollution of the water, air and soil.

**Taxonomy Level:** 2.7-B Understand Conceptual Knowledge

- My Bag
- Recycling: A Valuable Lesson

**6-2** The student will demonstrate an understanding of structures, processes, and responses of plants that allow them to survive and reproduce.

- Don't Take a Lichen for Pollution

**6-3** Students will demonstrate an understanding of structures, processes, and responses of animals that allow them to survive and reproduce. (Life Science)

- Oil and Water

**6-3.1** Compare the characteristic structures of invertebrate animals (including sponges, segmented worms, echinoderms, mollusks and arthropods) and vertebrate animals (fish, amphibians, reptiles, birds and mammals).

**Taxonomy Level:** 2.6-B Understand Conceptual Knowledge

- Can You Dig It?

**6-4** The student will demonstrate an understanding of the relationship between Earth's atmospheric properties and processes and its weather and climate. (Earth Science)

- Temperature Inversion

**6-4.1** Compare the composition and structure of Earth's atmospheric layers (including the gases and differences in temperature and pressure within the layers).

**Taxonomy Level:** 2.6-B Understand Conceptual Knowledge

- The Greenhouse Effect

**6-4.2** Summarize the interrelationships among the dynamic processes of the water cycle (including precipitation, evaporation, transpiration, condensation, surface-water flow, and groundwater flow).

**Taxonomy Level:** 2.4-B Understand Conceptual Knowledge

- Taking the Swamp Out of Swamp Water
- We All Live Downstream

**6-4.7** Explain how solar energy affects Earth's atmosphere and surface (land and water).

**Taxonomy Level:** 2.7-B Understand Conceptual Knowledge

- Can You Dig It?

**6-5** The student will demonstrate an understanding of the law of conservation of energy and the properties of energy and work. (Physical Science)

- When They're Gone, They're Gone

**6-5.1** Identify the sources and properties of heat, solar, chemical, mechanical, and electrical energy.

**Taxonomy Level:** 1.1-B Understand Conceptual Knowledge

- Recycling: It's An Energy Issue

**7-4.5** Summarize how the location and movement of water on Earth's surface through groundwater zones and surface-water drainage basins, called watersheds, are important to ecosystems and to human activities.

**Taxonomy Level:** 2.4-B Understand Conceptual Knowledge

- Oil and Water
- Taking the Swamp Out of Swamp Water

**7-4.6** Classify resources as renewable or nonrenewable and explain the implications of their depletion and the importance of conservation.

**Taxonomy Level:** 2.5,7-B Understand Conceptual Knowledge

- Look in Your Garbage Can
- Environmental Shopping
- Population and Garbage
- Recycling: A Valuable Lesson
- When They're Gone, They're Gone

# Backyard Composting

You've heard about it, but you are not really sure you want to do it.

Well, here's the dirt on composting. It's simple to do. All you need to get started is a little time, a little space, a bin and a basic understanding of the composting process.

Still not convinced? Composting helps protect the environment. Composting conserves natural resources. And composting saves you money.

Got your attention now? Good. Let's define composting.

You recycle, right? Well, composting is nature's way of recycling. Composting is the controlled natural decomposition of organic material (from plants and animals) such as leaves, yard trimmings, grass clippings and manure as well as fruit and vegetable scraps. Microorganisms break down this material into compost, a crumbly, dark-colored, earthy-smelling, soil-like material. That material is a nutrient-rich product that can be used in your garden, flower beds and lawn.

Composting can be practiced almost anywhere – including your backyard. Why on earth would you want to do that? There are lots of reasons.

## Benefits of Backyard Composting

There are many benefits to backyard composting.

- Compost is a valuable product. Compost improves soil by increasing aeration (the ability of air to circulate) and water-holding capacity (reducing your need to water) as well as helping plants absorb nutrients. Compost also helps suppress plant diseases and pests.
- Compost reduces or eliminates chemical fertilizer and pesticide use. That saves you money as well as helps protect the environment by reducing runoff pollution to nearby streams, rivers and lakes.
- Compost reduces the amount of waste a household generates. Yard trimmings and food scraps make up about one-fourth of the total amount of municipal solid waste generated by households according to the U.S. Environmental Protection Agency (EPA). It also is important to remember that yard trimmings are biodegradable and generally clean. Disposing of them in landfills often is unnecessary and is a waste of space.
- You save money. You save money by buying fewer bags for garbage and leaves. You also save money by buying fewer bags of compost from retail outlets. You make your own valuable product at home for free.

### Did You Know?

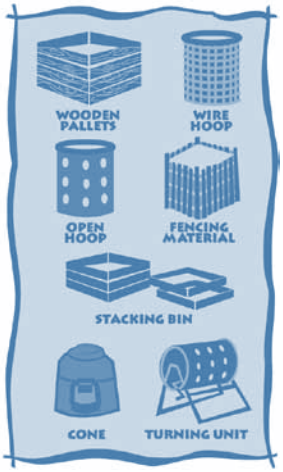
South Carolina and most other states – in order to encourage recycling and save landfill space – do not allow grass clippings and other yard trimmings to be disposed of in Class 3 landfills. The intent of the law is to encourage local governments to set up large-scale mulching and composting operations. Unfortunately, in many South Carolina counties that has not happened and the yard trimmings are disposed of at a different type of landfill. There are counties, however, that divert yard trimmings to mulching or composting facilities that use the end product beneficially in landscaping and other similar applications.

## Want to get started? Let's break it down.

Backyard composting can be as basic or as fancy as you like. How much time and effort do you want to spend on it? How quickly do you want results? You may want to begin with a simple approach.

- Location, location, location. Pick a spot in your yard (you will need an area about 3 feet by 3 feet) that is at least 2 feet from a structure like your house or a fence. The spot should be partially shaded so that the sun doesn't dry your compost too quickly (but try to stay away from large trees that may penetrate your compost with roots). The spot should be convenient for you to add materials, have access to water and have good drainage. You may want to plan for extra space around your pile to make turning and harvesting your compost easier.

- Begin with the bin. You can build a compost pile on the ground, but using a compost bin will help keep your compost pile neat and tidy, deter rodents from digging into your pile and help your pile retain heat and moisture. Compost bins can be homemade or purchased. Homemade bins can easily be built out of wood, wire mesh and scrap pallets. You even can build a compost corral with concrete blocks or chicken wire. Some manufactured bins include turning units, cone shaped bins and bins with stacking tiers. Some are wood and some are plastic (sometimes recycled plastic). These bins can be purchased at nurseries and garden centers or directly from the manufacturer. Bins are available in a wide range of prices. Take the time to consider your options and what works best for you.




- Size matters. Ideally, your compost pile should be at least 3 feet wide, 3 feet deep and 3 feet tall – big enough to work and small enough to be easily turned. Backyard compost piles probably should not be larger than 5 X 5 X 5 feet.

- Guess who's coming to dinner? Making compost is a lot like cooking a meal. You take some basic ingredients, add water, mix well and let it cook over a given period of time. You could have finished compost ready to use in as little as 12 weeks.

Four basic ingredients are required for composting – greens, browns, water and air. Mixing the proper amounts of these ingredients will provide the composting organisms (microbes and insects) with enough nitrogen, moisture and oxygen to break down the material effectively.

Greens include green leaves, fresh clippings and vegetable scraps. Do not add any meat or dairy products. Browns include dead leaves, wood chips, dry twigs and paper.

Water is important. Too little moisture will inhibit the composting process. Too much moisture will cause the compost pile to smell. Here's a simple rule to follow – the pile should be as moist as a sponge.

Air is essential. Turn your compost pile once or twice a week to inhibit odor-causing bacteria and to speed up the composting process.

## Where can you get help?

The S.C. Department of Health and Environmental Control's Office of Solid Waste Reduction and Recycling (Office) offers workshops, printed materials and other assistance on composting through its Smart Gardener Program.

To learn more about composting or the Smart Gardener Program, call **1-800-768-7348** or visit **www.scdhec.gov/environment/lwm/recycle/compost.htm**. The Office also offers a composting guide "Home Composting Made Easy" at no charge. (Call for availability.)

Many local governments also offer workshops with opportunities to buy compost bins at reduced prices or at cost. Check with your local recycling coordinator.

Clemson University Extension Service offers composting and mulching information at **www.clemson.edu/extension** or **hgic.clemson.edu**.

The EPA offers a wealth of composting information on its Web site. You can begin at **www.epa.gov/epaoswer/non-hw/composting/backyard.htm**.

# Buy Recycled ... and Beyond

What is buying recycled? Buying recycled is buying products made from recycled materials. Products made from recycled materials are called recycled-content products.

Recycling is a three-step process. That's why the recycling symbol ♻ has three arrows that complete a loop. The first step is collection – that's when you put your recyclables such as aluminum cans, plastic bottles, glass bottles and newspapers into your curbside recycling bin or into the bins at the drop-off center. The second step is manufacturing – that's when the recyclables are processed into raw materials to make new products. The third step is buying recycled – that's when you complete the recycling loop.

## Are recycled-content products hard to find?

No. All the materials you recycle, such as aluminum, paper, plastic, glass and cardboard, are made into thousands of recycled-content products. You may be buying recycled and not know it. You go to the grocery store, right? Most cereal boxes, aluminum and steel cans, and glass bottles have recycled content. Many products you use at home, including paper towels, garden hoses, compost bins, detergent bottles, plastic lumber, paint, carpeting, insulation, clothing and shoes, can be made from recycled materials. Many office and school supplies such as notebooks, notebook paper, copy paper, legal pads, pens and pencils also can be made from recycled materials.

Do recycled-content products cost more? Many of these products are priced competitively with their non-recycled counterparts. Some recycled-content products do cost more, but often an increase in demand for those products will allow manufacturers to lower their cost.

Are recycled-content products inferior? There are inferior and superior products no matter what you buy. Recycled-content products are no exception. Despite what some critics say, the quality and performance of recycled-content products are not automatically inferior to their non-recycled counterparts. It's almost an urban legend that recycled-content copy paper doesn't work as well in printers and copiers as non-recycled paper. Recycled-content products are manufactured to the same performance standards as virgin products.

## Is it a recycled-content product?

When shopping, look for the arrows on the products you buy and read the label. That's the best way to identify recycled-content products. There are a few terms that you need to know.

Post-consumer material comes from products used by consumers and collected for recycling. Pre-consumer material is not used by consumers

## Why buy recycled?

Buying recycled-content products creates demand for recycled materials and sustains local recycling programs. Without a demand for recycled-content products, there would be no reason to collect recyclables. If no one buys recycled, recycling will not work. Buying recycled has many other environmental and economic benefits. See "Five Good Reasons to Buy Recycled" on the back of this fact sheet.

## Green Purchasing

South Carolina state government is committed to environmentally preferred purchasing in recognition of the need to more efficiently use natural resources, reduce waste, save money, sustain markets for materials collected in recycling programs and protect South Carolina's environment, economy and the quality of life of all its citizens.

Visit **www.mmo.sc.gov** for more information.

but rather collected as a waste material during manufacturing such as paper trimmings at a paper mill. Choosing products with a higher content of post-consumer material helps sustain local recycling programs. It's important to know that most products are not made completely from recycled material. For example, copy paper may have a total recycled content of 50 percent, comprised of 30 percent post-consumer material and 20 percent pre-consumer material. The remaining 50 percent is made from virgin materials.

What is the difference between recycled and recyclable? A recycled product is one made from recycled material. A recyclable product is one that can be collected for recycling. Remember, buying a recyclable product only has meaning if that product can be recycled in your community. For more information, see the "Do Your Part: Be a 'Green' Shopper" fact sheet at **www.scdhec.gov/environment/lwm/recycle/info_for_you.htm**.

## Let's go shopping.

Here are some tips to keep in mind when shopping.

- Buy only what you need. Use what you buy.
- Buy products made from recycled materials.
- Bring your own reusable shopping bags. This is the best way to avoid the paper vs. plastic dilemma. Durable canvas bags are light-weight and convenient and can be used thousands of times. Reusable bags can easily become a habit and save an astonishing amount of paper and plastic over time. When you are shopping at the mall, combine bags instead of getting a new bag for every item purchased.
- Buy less packaging. You don't want to buy garbage, right? Well, depending on what products you buy, that may be what you are doing. Don't buy stuff that is over packaged. Packaging waste, for example, makes up more than 30 percent of the nation's waste stream – and you pay for it. Compare the size of the package to the size of the product. If the package is designed to take up as much shelf space as possible, choose a competing product. Do without products that are packaged inside more than one layer. Multi-pack juice boxes for children, made with layers of cardboard, plastic, aluminum and a plastic straw attached, are a particularly wasteful example. Avoid "single-serve" packages. Buy fruit and vegetables loose. Choose products that are not in plastic trays and that do not have attached promotional materials.
- Buy in bulk and/or concentrates. These practices reduce packaging, save you money and reduce trips to the store. Buy large single containers instead of the same volume in many smaller containers (e.g., two-liter bottles vs. six packs). For any item with a long or unlimited shelf life (e.g., laundry detergent) or non-perishable foods you use regularly (e.g., cereals and grains), buy the biggest container you can. Put manageable amounts in reusable, smaller containers for everyday use. Don't be fooled – some bulk packages are just individually wrapped items that are packaged yet again.
- Buy recycled paper packaging. Pass up polystyrene (Styrofoam) egg cartons. Choose paper cartons made from recycled newsprint. For paperboard boxes (such as cereal and cracker boxes), the rule of thumb is: if the inside is gray, it's made from recycled material. Most paperboard boxes have the "100% Recycled Paperboard" logo on them.
- Look at the container or packaging and think 'recycling.' Choose the container that can be recycled in your community. For example, if glass is not accepted for recycling in your community, avoid products packaged in glass containers. Avoid products that are difficult to recycle (e.g., many "squeezable" plastics which are made of numerous layers of different plastics) and instead purchase the type of container that can be recycled locally.
- Avoid throwaway products. Avoid single or limited-use items such as throwaway cleansing pads, non-refillable pens, plastic razors and foil baking pans. Reduce or eliminate your use of disposable plastic diapers – which account for 2 percent of the total U.S. landfill volume.

**What's the bottom line?** Think carefully about your purchases and their impact on the environment.

### WANT TO LEARN MORE?

For more information on buying recycled and other solid waste issues, please call the S.C. Department of Health and Environmental Control's Office of Solid Waste Reduction and Recycling at **1-800-768-7348** or visit **www.scdhec.gov/recycle**.

For more information on buying recycled and related topics, visit the following Web sites.

- **www.epa.gov/garbage/buyrec.htm**
- **www.greenseal.org**
- **www.edf.org**

### FIVE GOOD REASONS TO BUY RECYCLED

- **Buying recycled completes the recycling loop and makes recycling work.**
- **Buying recycled reduces the amount of waste disposed of in landfills.** The recycled materials are made into new products saving landfill space and reducing the need to build landfills.
- **Buying recycled conserves natural resources.** Making new products out of recycled materials instead of raw materials helps build a sustainable future.
- **Buying recycled reduces or eliminates pollution by reducing the need to extract, move and process raw materials.** In most cases, making products from recycled materials creates less air pollution, water pollution and waste than making products from raw materials.
- **Buying recycled saves energy.** Products usually take less energy to make from recycled materials than raw materials. For example, it takes 95 percent less energy to make aluminum from recycled aluminum than raw materials.

# Garbage 101

Let's talk trash. One of the things that we probably do every day is throw away garbage. The act is so common that it doesn't even register. We've all heard the cliché: "Out of sight, out of mind." Well, even when garbage is in sight, it seemingly passes under our eyes virtually unnoticed. But it's there. Then it's gone.

## How much garbage do we make?

That question is not as simple to answer as it would seem. Just think of all the different sources – or generators – of garbage. You make garbage, right? And your family makes garbage. And schools, businesses, organizations and industries make garbage. Everybody makes garbage. And everybody makes different kinds of garbage.

Before reading any further, here's a term you need to know. What you call trash or garbage, professionals call solid waste. There are different kinds of solid waste, but one type measured nationwide by the U.S. Environmental Protection Agency (EPA) and in South Carolina is municipal solid waste (MSW).

What is MSW? MSW has many definitions throughout the nation. In South Carolina, however, MSW is defined as the combined residential, commercial, institutional/non-profit and industrial packaging/office waste that is generated. This includes paper, cans, bottles, food scraps, yard trimmings, packaging and other items. It does not include industrial process waste like scraps and by-products from the manufacturing process, construction and demolition (C&D) debris, automobile bodies, agricultural waste, combustion ash, mining waste and sewage sludge as well as hazardous, infectious and radioactive waste.

According to the S.C. Solid Waste Policy and Management Act of 1991 (Act), county governments are required to report annually to the S.C. Department of Health and Environmental Control (DHEC) the amount of MSW recycled within their county. Permitted solid waste facilities also are required to report the amount of waste disposed of at their facilities annually to DHEC.

## Where does the garbage (MSW) go?

Of the 4.2 million tons of MSW generated in South Carolina in FY11, 1,172,768 tons or 28 percent of the state's MSW stream was recycled. Of the remaining amount, nearly 3.1 million tons of MSW or 72 percent was disposed of in the state's 24 Class 3 landfills.

There are other places MSW – which can be moved by truck, rail or barge – may go before being disposed of in a landfill, sent to an incinerator or

### And the number is ...

So, how much MSW did we make? South Carolinians generated about 4.2 million tons of MSW in fiscal year (FY) 2011 (July 1, 2010 - June 30, 2011) according to the S.C. Solid Waste Management Annual Report for FY11. The amount of MSW generated in (calendar year) 2010 (the latest numbers available) nationwide was 250 million tons according to the EPA.

How much MSW do we dispose of every day? South Carolinians disposed of 3.6 pounds of MSW per person per day (p/p/d) in FY11. By comparison, Americans discarded 2.9 p/p/d in 2010 according to the EPA.

recycled. Some MSW is taken to a transfer station where it is compacted and loaded on large trailers. This is done usually when the community is a long distance from a landfill. Some MSW is taken to a material recovery facility where recyclables are sorted from the garbage. The recyclables are taken to companies who process the materials and make them into new products while the garbage goes to a Class 3 landfill or MSW incinerator.

## What's in our garbage?

The EPA calculates – by weight – what makes up the nation's MSW stream. In 2010, of the total MSW generated before recycling, paper and paperboard (which includes office paper, newspaper and cardboard boxes) was the largest category, comprising 29.0 percent or 71.3 million tons. Food scraps were second (13.9 percent or 34.76 million tons) followed by yard trimmings (13.4 percent or 33.4 million tons), plastic (12.4 percent or 31.04 million tons) and metal (including aluminum cans and steel cans – 9.0 percent or 22.4 million tons). Rubber, leather and textiles (8.4 percent or 20.9 million tons), wood (6.4 percent or 15.88 million tons) and glass (4.6 percent or 11.53 million tons) rounded out the top eight categories. The remaining amount (3.4 percent or 8.63 million tons) was classified as "other."

South Carolina measures the total MSW generated, but not the total amount of a specific waste category. To estimate how much of a specific category of material is being generated in South Carolina, we can use the national percentages determined by the EPA. There were 4.2 million tons of MSW generated before recycling in South Carolina in FY11. That means that by using the EPA's figure of 29.0 percent of the total MSW generated being paper and paperboard products, South Carolinians generated an estimated 1.17 million tons of paper and paperboard products in its MSW waste stream. This is only an estimate, but should serve as a reasonable guide.

Other estimates of what South Carolinians generated before recycling include food scraps (583,800 tons), yard trimmings (562,800 tons), plastic (520,800 tons), metal (378,000 tons) and glass (201,600 tons). Again, these are estimates based on the EPA's national numbers.

### THINK BEFORE YOU THROW ...

You know the three Rs – reduce, reuse and recycle. Waste reduction, which is making less garbage in the first place, is the preferred option of waste management. Reduction is followed by reuse, which means repairing items, donating them to a charity or selling them. Reuse is followed by recycling and composting – both of which turn materials that would become waste into valuable new resources.

Disposing of garbage at a landfill or burning it at an incinerator should be the last option for waste management. To learn more about garbage and ways you can reduce the amount you generate at home, at school and at work or more about recycling, composting and buying recycled, call DHEC's Office of Solid Waste Reduction and Recycling at **1-800-768-7348** or visit **www.scdhec.gov/recycle**.

# Hazardous Household Products

Hazardous household products are in your home, your neighbor's home and your best friend's home.

From under the kitchen sink to the garage and all storage places in between, a typical house has about 100 pounds of them according to the U.S. Environmental Protection Agency (EPA). If not used, stored and disposed of properly, they can be hazardous to your family's health and the environment.

## What are hazardous household products?

Household products that are hazardous contain at least one hazardous substance – that is, any material that poses a threat to you or the environment. As a consumer, you might assume that a product is safe if it is for sale. You need to remember that there are thousands of common household products that contain at least one hazardous substance. The products include cleaners, pool chemicals, lawn and garden care products, paint products, automotive fluids, medicine and some beauty products. Products that are hazardous have at least one of the following characteristics:

- **FLAMMABLE** – it can easily be set on fire.
- **CORROSIVE** or **CAUSTIC** – it can burn you.
- **EXPLOSIVE** or **REACTIVE** – it can explode if exposed to heat, sudden shock or pressure.
- **TOXIC** or **POISONOUS** – it can cause injury or death through ingestion, inhalation or absorption through the skin.

## What is hazardous household waste?

Hazardous household waste (HHW) is leftover hazardous household products generated by residential consumers as opposed to manufacturers and businesses. The average home can accumulate as much as 100 pounds of HHW according to the EPA.

## What are the possible dangers?

The dangers may not be immediately obvious, but the improper disposal of HHW can pollute the environment and pose a threat to human health.

Flammable or reactive HHW mixed in your garbage can release toxic fumes, explode or catch fire injuring your family or sanitation workers. If poured down drains and toilets, it can contaminate septic tanks or wastewater treatment plants. If poured on the ground or down storm drains, it can contaminate rivers, lakes and streams.

## What can I do at my home?

Here are some steps that you can take to protect your family and the environment.

- **Buy wisely.**
  - ☐ Read the label carefully. Make sure the product will do the job you want it to do.
  - ☐ Buy only what you need to avoid leftover product.
  - ☐ Consider buying non-toxic or less toxic alternatives.
- **Store products safely.**
  - ☐ Close lids tightly so products will not dry out, leak or evaporate.
  - ☐ Store products in a cool, dry place away from heat or flame. Store away from children and pets.
  - ☐ Store products in original containers with the label intact.
  - ☐ Separate flammables, corrosives and poisons. Store them on separate shelves.
- **Use products safely.**
  - ☐ Read the label carefully before use and follow directions.
  - ☐ Use only the recommended amount.
  - ☐ Never mix products.
  - ☐ Use the product in well-ventilated rooms and avoid breathing fumes.
  - ☐ Use any eye or ear protection, gloves and protective clothing recommended.

There can be certain health threats associated with the use of hazardous household products. Products like lye can burn skin, eyes or respiratory passages. Exposure to some pesticides, paints and solvents can cause weakness, confusion, dizziness, irritability, headaches, nausea, sweating, tremors and convulsions. Children are particularly vulnerable to these products and accidental poisonings can occur if these products are not properly stored. Pets can be at risk, too.

It may seem that what you throw away is insignificant, but it is not when multiplied by millions of homes nationwide that throw away HHW.

## How can I identify a hazardous household product?

Carefully read the product label. To help identify these products, federal law requires them to be labeled with warnings about their use, storage and disposal. These labels include signal words to help in their identification. The words "Danger" (most toxic), "Warning" and "Caution" (least toxic) are used to help identify the various degrees of toxicity.

It is important to note that some of these requirements do not apply to most hobby products. Labels do, however, provide valuable information that you can use to make informed choices about what products to buy, how to store and use them, and how to dispose of them properly.

## How is HHW managed in South Carolina?

The waste management options in order of preference are waste reduction, reuse, recycling and disposal. Every effort should be made to minimize HHW. Using a non-toxic or less toxic alternative is the best option. If you cannot use the product, donate it to a friend or community organization.

Homeowners in South Carolina are legally allowed to dispose of HHW with their household garbage. There are some counties in the state that have permanent HHW programs. Other local programs offer single-day collection events. If your community does not have a program or plans for a collection event, encourage it to set up one. Call the S.C. Department of Health and Environmental Control's Office of Solid Waste Reduction and Recycling at **1-800-768-7348** or visit **www.scdhec.gov/recycle** for more information on programs or events.

## The Final Word

Proper management of hazardous household products and HHW is everyone's responsibility. You should reduce the use of these products whenever possible and reduce the amount of HHW generated for disposal. Your actions will help protect your family's health and the environment.

For more information about the hazards, handling and management of hazardous household products, visit **www.mass.gov/dep/recycle/hazardous/hhwhome.htm**.

### EXAMPLES OF HAZARDOUS HOUSEHOLD PRODUCTS

- **LAWN/GARDEN CARE PRODUCTS** – Bug spray, fertilizer, pesticide, insecticide, fungicide, herbicide and weed killer
- **PAINT AND PAINT-RELATED PRODUCTS*** – Latex/water-based paint, oil-based paint, turpentine, paint stripper, rust remover, paint thinner and varnish
- **AUTOMOTIVE FLUIDS AND BATTERIES**** – Used motor oil and filters, gasoline, diesel fuel, kerosene, auto body repair products, windshield washer solution, antifreeze, brake and transmission fluid, lead-acid batteries and metal polish
- **BEAUTY PRODUCTS AND MEDICINE** – Alcohol-based lotions, rubbing alcohol, medicine, nail polish and nail polish remover, hair relaxers, dyes and permanents, hair sprays and aerosol deodorants
- **HOUSEHOLD CLEANERS** – Ammonia-based cleaners, oven and drain cleaners, floor care products, aerosol cleaners, window cleaners, furniture polish, metal polish as well as tub/toilet cleaners
- **MISCELLANEOUS** – Mercury thermometers, photographic chemicals, lighter fluid, shoe polish, fiberglass epoxy, swimming pool chemicals, mothballs and glue

* If the paint is still usable, try to donate it to a non-profit group in your community. Many counties also accept latex paint from residents. Paint also can be disposed of safely by completing the following steps: (1) Remove the lid and let the paint air dry (harden) completely. Make sure you do this in a well-ventilated area away from children and pets. (2) You can add cat litter, shredded newspaper, sawdust or sand to the paint to speed up the process. (3) Once the paint is completely dry, you can dispose of it with your household garbage.

** Used motor oil and filters as well as gasoline, diesel fuel and kerosene can be recycled throughout South Carolina. For the location nearest you, visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE. Lead-acid (car and truck) batteries must be recycled in South Carolina. You can recycle your batteries at the retail location where you bought your new battery or through your local recycling program.

# Landfill 101

In an ideal world, we wouldn't throw anything away. We would reuse or recycle it. In the real world, however, some things are thrown away and usually end up in a landfill.

All of us make solid waste – commonly known as trash or garbage. The waste we make is managed for us. How? What we don't reuse or recycle is burned (sent to an incinerator) or disposed of (sent to a landfill).

Just what is a landfill? A landfill is a large, outdoor site designed for the disposal of waste. There are different kinds of landfills that accept different material including construction and demolition (C&D) debris landfills, industrial, hazardous waste and land-clearing debris. But, generally, the trash and garbage that we throw away every day – also known as municipal solid waste (MSW) – is disposed of in a Class 3 landfill. For more information on how much we dispose of in Class 3 landfills, see the "Garbage 101" Lesson Resource page.

Landfills are a fact of life. Although waste reduction, reuse, recycling and composting divert large amounts of MSW from disposal, some waste still must be disposed of in landfills.

## Landfills are not just holes in the ground.

In the past, there were few or no regulations regarding landfills. It showed. Many people remember smelly, unlined dumps that contaminated groundwater and caused other environmental problems. It's different today. Modern landfills are well-engineered facilities that must meet strict U.S. Environmental Protection Agency (EPA) and S.C. Department of Health and Environmental Control (DHEC) regulations that were established to protect human health and the environment. All landfills must be approved (receive a permit) from DHEC. When you think of it this way – and most of us don't – garbage disposal is no less an essential public service than police or fire protection.

Class 3 landfills must be built in suitable geological areas away from faults, wetlands, flood plains and other restricted areas. The design of landfills includes plastic liners and other materials like clay to prevent groundwater contamination. Monitoring is required to test groundwater quality and determine if there is any contamination. Daily operation of landfills includes compacting (crushing) and covering waste with several inches of soil or other cover material to reduce odor, litter and control rodents and pests. Closed landfills must have a final cover that includes a synthetic cap and a soil layer. Once the landfill is closed, the responsibility of the landfill operator doesn't end. Landfill operators must set aside funding to provide environmental protection during and after the closing of a landfill. In short, today's landfills are expensive to design, build and maintain.

## The Myth of Biodegradation

Most of us assume that when we throw something away, it will eventually break down or decompose in the landfill. You know, a return to nature kind of thing. Well, not necessarily. It depends on what was thrown away – and a lot of other things.

One of the most recognized research efforts on decomposition – also called biodegradation – has been the work done as part of the Garbage Project at the University of Arizona. Researchers mined local landfills to learn about modern civilization. Among their findings – garbage does not break down in landfills.

The Garbage Project discovered that landfills are a much more static structure and that biodegradation takes a lot longer than previously thought. Air and water are necessary for biodegradation. Under normal landfill conditions – that is when the garbage is covered by dirt and the landfill is relatively dry – the only garbage that truly decomposes are certain types of food scraps and yard trimmings (banned from Class 3 landfills in South Carolina) and even that takes a long time. Hot dogs and pastries, buried as long as 15 years before the project took place, were still recognizable. Grass clippings were still green. Newspapers, long thought to be easily biodegradable, were found in landfills virtually intact after being buried for decades. The bottom line is this: throwing something away is a lifetime decision in more ways than one.

Beyond the expense, landfills also are difficult to build simply because the public frequently opposes new construction. People remember the poor practices of the past and are concerned about their health and the environment as well as property values, noise, odor and traffic if a landfill is built near their community. But the modern landfill was designed to lessen or overcome these problems, particularly open dumps and garbage incinerators that polluted the air.

## What's going on today?

Nationwide, the number of active landfills has shrunk from nearly 8,000 in 1988 to 1,908 in 2009 according to the EPA. There are thousands of closed landfills. In South Carolina, there were 25 permitted Class 3 landfills operating in fiscal year 2010 (July 1, 2009 to June 30, 2010). But what landfills lack in numbers is made up in size. Landfills are much bigger today than they were in the past. As such, today's landfills have a much longer lifespan and frequently accept waste from a much larger geographical area.

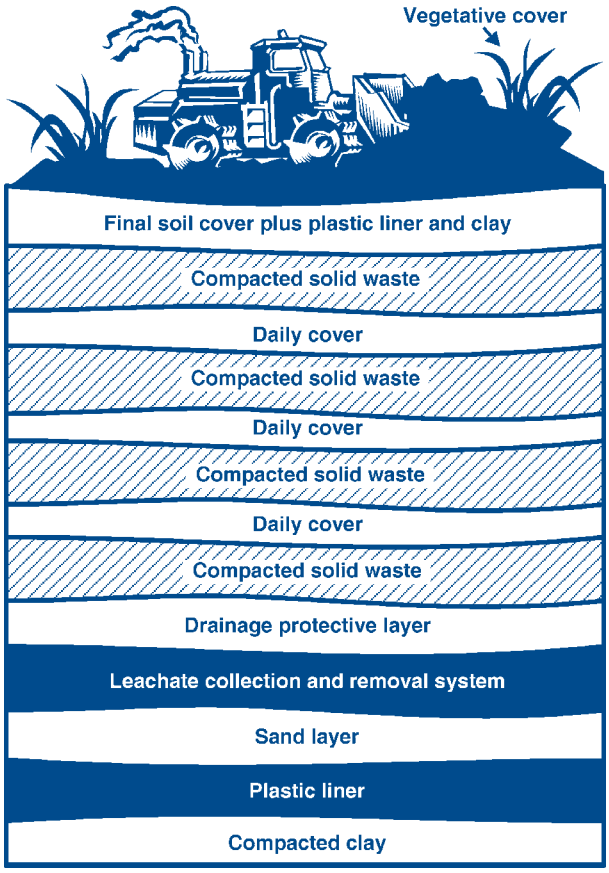
## Think before you throw.

For now, like them or not, there is a need for landfills. But each of us should do our part to reduce, reuse, recycle and compost whenever possible to save landfill space as well as natural resources and energy. For more information, visit DHEC's Office of Solid Waste Reduction and Recycling Web site at **www.scdhec.gov/recycle** or call **1-800-768-7348**.

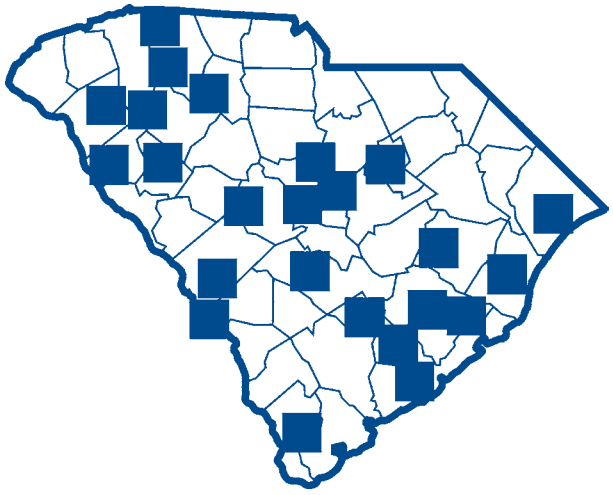
### A BRIEF HISTORY OF LANDFILLS

Who invented the modern landfill that led to the landfills of today? No one knows. Some experts say the British did in the 1920s. Others say there were "sanitary" landfills (landfills where the new garbage is covered daily by some material) in the U.S. earlier than that, for example, in Champaign, Illinois in 1904.

This much is certain – wherever and whenever the first modern landfill was built and all those built afterwards, the drive to build them was public health. People realized that open dumps were causing sickness in the community. "Sanitary" landfills gradually caught on in the 1930s but got their biggest boost from the U.S. Army Corps of Engineers, which made sanitary landfills the disposal method of choice for military facilities during World War II. By 1945, about 100 American cities had "sanitary" landfills. Within 15 years, that number had increased to about 1,400.




**South Carolina's Permitted Solid Waste Disposal Facilities**



■ Class 3 Landfill

**SOURCE:** "S.C. Solid Waste Management Annual Report for Fiscal Year 2011"

# Natural Resources

Natural resources are materials from the Earth that are used to support life and meet people's needs.

Any natural substance that humans use can be considered a natural resource. Oil, coal, natural gas, metals, stone and sand are natural resources. Other natural resources are air, sunlight, soil and water. Animals, birds, fish and plants are natural resources as well.

Natural resources are used to make food, fuel and raw materials for the production of goods. All of the food that people eat comes from plants or animals. Natural resources such as coal, natural gas and oil provide heat, light and power. Natural resources also are the raw materials for making products that we use everyday from our toothbrush and lunch box to our clothes, cars, televisions, computers and refrigerators.

## Renewable and Nonrenewable Resources

Renewable resources are those natural resources such as trees, water, sun and wind that can be replenished at about the same rate at which they are used. Renewable resources, however, can be depleted if not properly managed or conserved.

Nonrenewable resources are those natural resources that are depleted more quickly than they can regenerate. Fossil fuels like oil and natural gas were formed over millions of years. Once mined and used completely, nonrenewable resources are gone forever.

## The Challenges of Using Natural Resources

Extracting, processing and using natural resources can cause environmental problems such as: air, land and water pollution; disruption or destruction of ecosystems; and a decrease in biodiversity.

For example, carbon dioxide – which is produced from burning coal, oil and natural gas (fossil fuels) – is a critical greenhouse gas. Greenhouse gases absorb and retain heat from the sun. Examples of greenhouse gases include methane, ammonia, sulfur dioxide and certain chlorinated hydrocarbons. Many scientists believe that the build up of greenhouse gases in the atmosphere can cause global climate change (change in the average global temperature of the atmosphere near the Earth's surface). Over time, this condition could pose dangers around the world such as flooding, drought and disease.

Extracting and using natural resources also can disturb relationships within ecosystems. What are ecosystems? Ecosystems, which include ponds, wood lots and fields, are self-regulating communities of

### Natural Resources in South Carolina

- Forests – a renewable resource – cover almost two-thirds of South Carolina's land area and are used to produce lumber and pulpwood for paper production.
- The state has large deposits of kaolin (a type of clay) as well as peat, sand, limestone and gravel.
- Granite is mined throughout the state for crushed stone used in construction or dimension stone used in monuments – including the World War II Memorial in Washington, DC.
- South Carolina is the nation's leading producer of vermiculite, which is used for insulation and as a medium for planting.
- In addition, there is a limited amount of gold mining in the state.

South Carolina has no known economic deposits of mineral fuels such as coal or natural gas.

plants and animals that interact with each other and their non-living environment. For example, trees cleared from a field can destroy habitats used by many animals, forcing them to find homes elsewhere. If these animals leave the ecosystem, further disturbances can occur within plant and animal populations that depend on these species.

Extracting and using natural resources – along with other human activities – may decrease biodiversity – that is the variety of organisms that live on the Earth. Diminishing the Earth's biodiversity has a substantial human cost because wild species and natural ecosystems are important resources. Some economists, for example, estimate that the lost pharmaceutical value from plant species extinctions in the United States is about $12 billion.

## How can you help?

There are many ways each of us can conserve natural resources. Reducing our consumption – that is reducing what we buy, buying products with less packaging, reusing what we can, composting and recycling – is one of the easiest ways.

*Information for part of this Lesson Resource page was provided by "The Quest for Less: A Teacher's Guide to Reducing, Reusing and Recycling," 2005 edition, U.S. Environmental Protection Agency (EPA).*

## Products Made from Natural Resources

People use an abundance of resources to survive in a continually developing world. Globally, however, some people live simpler lifestyles than others and therefore use fewer resources. This table lists some natural resources and the products and services people produce from them.

| NATURAL RESOURCE | PRODUCT/SERVICE |
|---|---|
| **Trees** | Paper, furniture, fuel |
| **Cotton** | Clothing |
| **Oil/petroleum** | Plastic, fuel |
| **Natural gas** | Fuel |
| **Coal** | Fuel |
| **Iron ore** | Steel products (cans, bridges) |
| **Bauxite ore** | Aluminum products (cans, car parts) |
| **Gold** | Jewelry, dental material |
| **Copper** | Wire, coins, electrical equipment |
| **Manganese** | Steel, cast iron |
| **Cobalt** | Steel, jet engine parts, cutting tools |
| **Platinum** | Air pollution control and telecommunications equipment, jewelry |
| **Chromium** | Stainless steel, green glass, leather treatment |
| **Diamonds** | Jewelry, mechanical equipment |

**SOURCE:** "The Quest for Less: A Teacher's Guide to Reducing, Reusing and Recycling," 2005 edition, EPA.

### RESOURCE RECOVERY

Natural resources used for the first time are considered virgin resources and their extraction, processing and use require a great deal of energy and can create pollution.

Resource recovery is a practice that conserves natural resources by extracting material (e.g., paper, glass, aluminum and steel) from the waste stream and recycling it into other materials or using it to produce energy. More and more companies are developing new and innovative technologies that use recycled materials in the manufacturing of products. Many steel mills, for example, use a manufacturing process that uses virtually 100 percent recovered steel as the raw material.

Here's another example. A company can create plastic from oil, a virgin natural resource, or it can use recovered plastic from recycling programs. If a company uses recovered plastic, it is recycling material that would otherwise become waste, helping prevent the depletion of natural resources, conserving energy and preventing pollution that would have been created in the extraction and processing of oil from the ground.

### RESOURCE RECOVERY IN ACTION

- Recycling or reuse of 2,000 pounds of paper saves 7,000 gallons of water and 380 gallons of oil.
- Using recovered aluminum cans saves 95 percent of the energy required to make the same amount of aluminum from bauxite ore – its virgin source.
- Steel is the most recycled material in North America, with a national recycling rate of 88 percent.
- For every ton of recovered glass (cullet) used to make new glass, more than 2,000 pounds of raw materials are saved – including 1,300 pounds of sand, 410 pounds of soda ash, 380 pounds of limestone and 160 pounds of feldspar. Using recovered glass also saves energy and reduces greenhouse gas emissions.

**SOURCE:** American Forest and Paper Association; Aluminum Association; Steel Recycling Institute; and Glass Packaging Institute.

# Recycling 101

What is recycling? Recycling is placing items that can be made into new products or materials in the recycling bin or taking them to a drop-off center.

But, there's a little more to it than that.

Recycling is a three-step process. The first step is collection – that's when you put your recyclables into the bin or take them to a drop-off center. The second step is manufacturing – when the recyclables are processed into raw materials that are then manufactured into new products. The third step is buying recycled. You are not really recycling unless you are buying recycled-content products.

You have seen the recycling symbol ♻, right? The three arrows represent steps that complete the recycling loop.

## Why should I recycle?

Recycling has many environmental benefits. It reduces the need to build landfills and incinerators. Recycling conserves natural resources as well as energy. Recycling reduces pollution caused by the extraction and processing of raw materials as well as the manufacturing of products using raw materials.

Recycling also has many economic benefits. First, recycling turns items that otherwise would become waste into valuable resources. Recyclables have value. The recyclables you place in the bin or take to the drop-off center end up on the market as commodities that are bought and sold.

Recyclables, in fact, make up an essential part of today's marketplace according to the 2001 "U.S. Recycling Economic Information Study." In the United States, the recycling and reuse industry consists of about 56,000 businesses that employ more than 1.1 million people. These businesses have an annual payroll of $37 billion and gross more than $236 billion in annual revenues.

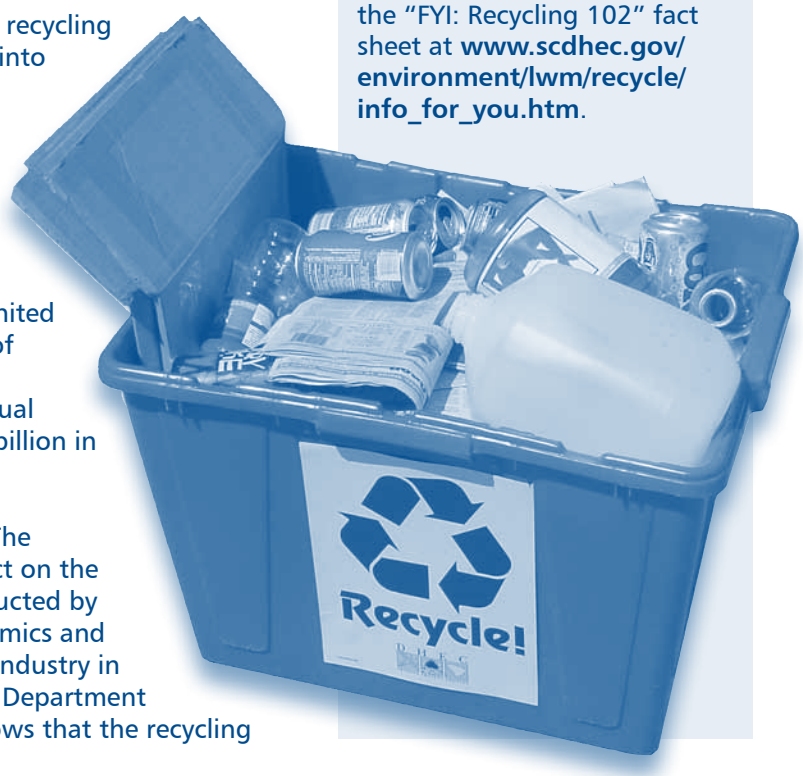
Recycling is big business in South Carolina, too. The recycling industry has a $6.5 billion annual impact on the state's economy according to a 2006 study conducted by the College of Charleston's Department of Economics and Finance. "The Economic Impact of the Recycling Industry in South Carolina" study, commissioned by the S.C. Department of Health and Environmental Control (DHEC), shows that the recycling

## Recycling works.

Recycling, in fact, is one of the nation's best environmental success stories. Americans recycled more than 85 million tons of municipal solid waste (MSW) in 2010 (the latest data available) – more than double the amount recycled in 1990 according to the U.S. Environmental Protection Agency.

South Carolinians recycled 1,172,768 tons of MSW in fiscal year (FY) 2011 (July 1, 2010 to June 30, 2011) and about 17 million tons of material since FY98.

To learn more about MSW, MSW recycling totals and MSW recycling goals, see the "FYI: Recycling 102" fact sheet at **www.scdhec.gov/environment/lwm/recycle/info_for_you.htm**.



industry is directly responsible for more than 15,000 jobs, $1.5 billion in annual personal income and $69 million in tax revenue each year.

To learn more about why we should recycle, see the "FYI: Environmental Benefits of Recycling" fact sheet and the "FYI: Economic Benefits of Recycling" fact sheet, both available at **www.scdhec.gov/environment/lwm/recycle/info_for_you.htm**.

## What should I recycle?

The most common materials collected for recycling include cardboard boxes, newspapers, steel (fruit, vegetable, soup and other food) cans, aluminum cans, plastic bottles, glass bottles, lead-acid batteries (car and truck), tires, used motor oil and large appliances.

Some local programs also collect non-traditional items for recycling. These items may include cooking oil, electronics, antifreeze and paint.

## Where do I recycle?

South Carolina has about 4.6 million residents and most have curbside recycling or recycling drop-off centers in their communities. Many South Carolinians also take advantage of recycling programs at work, school, state parks and welcome centers.

## What happens to my recyclables after I recycle them?

Well, they begin a circular journey. Here's the short version. The materials are collected and sorted at the curb, drop-off center or processing facility. They may be baled and sold for processing. Manufacturers purchase these processed materials and make them into new recycled-content products that they sell.

Here's where you come in again. You must buy recycled-content products to make it all work. (To learn more about buying recycled, see the "Buy Recycled ... and Beyond" Lesson Resource page.)

## What and where can I recycle?

If you don't know what or where you can recycle in your community, here's some help. Each of South Carolina's 46 counties and some municipalities have a recycling coordinator who can answer your questions. Look in the telephone book for your public works director, solid waste director or recycling coordinator.

You also can call DHEC's Office of Solid Waste Reduction and Recycling (Office) at **1-800-768-7348** or visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE for information about local programs in the state.

### HOW CAN I START A RECYCLING PROGRAM?

Want to set up a program at your school, office or in your community? The Office can provide education and awareness programs and materials, technical assistance and grant funding.

Please call **1-800-768-7348** or visit **www.scdhec.gov/recycle**.

### R-E-C-Y-C-L-E. IT BEGINS WITH YOU AND ME.

Government, businesses, organizations, schools, colleges/universities and consumers each play an important role in making recycling work. The role can vary – from participating in collection programs, to making recycled-content products to buying those products. Regardless, everyone needs to do their part. Remember, it's just right to recycle.

# Residential Recycling: Back to the Basics

It's just right to recycle. Recycling is good for the environment, human health and the economy. The recyclables that you place in your curbside bin or take to a drop-off center have value. By turning recyclables into material that can be bought and sold, recycling creates jobs and adds significantly to the nation's economy. Recycling promotes the sustainable use of natural resources. Recycling saves energy. Recycling reduces pollution. Recycling lessens the need to build landfills and incinerators. Recycling works.

## How does recycling work?

Recycling is not mandatory in South Carolina – it's voluntary. It's up to you. Local governments design and run the programs that need your participation to be successful. No matter how small or large your local recycling program, it's up to you to make it work by participating in it. The S.C. Department of Health and Environmental Control's (DHEC) Office of Solid Waste Reduction and Recycling (Office) was created to support local government recycling programs with grant funding, technical assistance as well as education and outreach programs.

## Where can I recycle?

Recycle at home, school and work – just about anywhere. South Carolina has about 80 curbside recycling programs and more than 650 recycling drop-off centers. There are recycling opportunities in each of the state's 46 counties. If you're on the go, take your recyclables home. Do-it-yourself oil changers can recycle used motor oil, filters and bottles at nearly 900 collection sites throughout the state.

## What can I recycle?

Most programs accept traditional recyclables such as aluminum cans, plastic bottles (soft drink, detergent, shampoo and other similar bottles as well as milk jugs), newspapers (including inserts), cardboard, steel cans (fruit, vegetable, soup and other food as well as beverage cans) and glass bottles (clear, green and brown). Programs also accept many other items such as magazines, office paper and unwanted mail.

## How do I find out what and where to recycle in South Carolina?

If you do not know what or where to recycle, call the Office at **1-800-768-7348** or visit **www.scdhec.gov/recycle** and click on RECYCLING WHERE YOU LIVE. You will find a listing of all the programs in your county, what is accepted, where and who to call locally for more information.

## What is the best way to prepare my recyclables?

It's great that you want to recycle, but a couple of simple tips will help you recycle the right way.

- Throw away lids and caps.
- Rinse bottles and cans.
- Remove plastic bags and rubber bands from newspapers.
- Flatten cardboard and plastic bottles.
- Generally, you should not bag your recyclables.
- Recycle only what your program accepts.

For general information on how to prepare your recyclables, see the "Residential Recycling Guide" on the back of this page. For specific information on what is required in your community, contact your local recycling coordinator.

Remember, quality is as important as quantity. It is better to leave an item out of a recycling container than to include one that does not belong. One wrong item can contaminate a whole load of recyclables.

# Residential Recycling Chart

This chart provides general information – or best practices – on what and how to recycle specific items. Please follow your local program guidelines. Items listed below are collected for recycling in one or more communities in South Carolina. For specific information about materials collected in your local program, visit **www.scdhec.gov/environment/lwm/recycle/counties.htm**.

| | DOs | DON'Ts |
|---|---|---|
| **ALUMINUM** | Food and beverage cans, foil, "pie" plates. Rinse and flatten. | Some program DO NOT ACCEPT foil or "pie" plates. |
| **APPLIANCES** | See METAL, SCRAP. | |
| **ANTIFREEZE** | Antifreeze | |
| **ATHLETIC SHOES** | Any brand. Laces OK. | NO cleats. Don't tie together. |
| **BATTERIES, LEAD-ACID** | Auto, truck, boat, motorcycle, lawnmower, etc. | |
| **BATTERIES, RECHARGEABLE** | Nickel Cadmium (Ni-cd), Metal Hydride (Ni-MH), Lithium Ion (Li-ion), Small Sealed Lead (Pb) less than two pounds. | NO alkaline batteries. |
| **BOOKS** | | |
| **CARPET PADDING** | | |
| **CARDBOARD** | Boxes and brown paper bags. Flatten. | DO NOT include paperboard cereal, beverage cartons, shoeboxes, etc. NO pizza boxes. Remove all packing material. |
| **CELL PHONES** | | |
| **COOKING OIL** | | |
| **ELECTRONICS** | | |
| **EYE GLASSES** | | |
| **FLUORESCENT BULBS** | | DO NOT break or crush. |
| **GLASS BOTTLES AND JARS** | Clear, green and brown bottles and jars. Labels OK. | DO NOT include window glass, drinking glass, pottery, porcelain or china. NO lids. |
| **MAGAZINES** | Magazines and other glossy paper such as high gloss advertising. | Do not bag or tie. |
| **METAL, SCRAP** | Appliances such as stoves, refrigerators, washers and dryers as well as grills, bicycles, etc. | |
| **MOTOR OIL** | Used motor oil, kerosene, power steering fluid, diesel, automatic transmission fluid, hydraulic fluid. | DO NOT include brake fluid, antifreeze, paint thinner or solvents. |
| **MOTOR OIL BOTTLES** | See PLASTIC BOTTLES, JARS AND JUGS. | |
| **MOTOR OIL FILTERS** | | |
| **MOTOR OIL/GASOLINE** | Gasoline or mixture of oil and gasoline | |
| **NEWSPAPERS** | Inserts OK. | DO NOT bag or tie. |
| **PAPER, MIXED OFFICE** | Mail, letterhead, notebook paper, sticky notes, envelopes (windows OK), copy paper, etc. | NO fluorescent colors. DO NOT bag. Staples OK. Shred if necessary. |
| **PAPERBOARD** | Packaging cartons for food (cereal, sodas, etc.) and household items. | |
| **PLASTIC BOTTLES, JARS AND JUGS** | Food, beverage and household products such as laundry, cleaning and shampoo. Rinse and flatten. Motor oil bottles must be drained properly (overnight) but not rinsed. Labels OK. | NO lids, tubs, bags, film or Styrofoam. |
| **PRINTER CARTRIDGES** | | |
| **STEEL CANS** | Food and beverage. Rinse. Labels OK. Push lids to inside. Include empty aerosol cans. | DO NOT puncture empty aerosol cans. |
| **TEXTILES** | Clothing, shoes, belts, purses, hats, towels, linens and blankets. | DO NOT bag. |
| **TELEPHONE BOOKS** | | |
| **TIRES** | Car, motorcycle, bus and truck tires without rims | |
| **YARD TRIMMINGS** | Tree limbs, leaves, brush, Christmas trees, etc. Bag or properly cover for taking to recycling, but empty bags to recycle. | NO stumps, large logs or treated wood. |

# Used Motor Oil Recycling

We love to drive. To the supermarket, to the mall, to school, to see friends, to get a pizza, to our job, to the beach or mountains and to a million places in between. We get in the car, buckle up and hit the road every day.

There are many responsibilities related to that privilege. Safety, for example. Buckle up. Slow down. Be careful. Another responsibility often forgotten is the environmental impact of driving. Cars and trucks, for example, release pollutants into the air. Cars and trucks use energy. And cars and trucks use motor oil. It's a fact of life. It's driven into you the moment you begin to drive: you have to change your oil periodically to maintain your vehicle and ensure that it runs properly. That's a lot of oil. In fact, about 1.1 billion gallons of motor oil are sold annually in the United States according to the American Petroleum Institute (API).

What do you do with your used motor oil after you change it? What can you do with it? What happens to it?

## Why recycle oil?

- Recycling used motor oil protects human health and the environment. Recycling used motor oil keeps it: from contaminating soil; out of rivers, lakes, streams and groundwater; and away from the beach, aquatic life and wildlife. The potential harm that improperly disposed of used oil may cause is staggering. One gallon of used motor oil improperly disposed of may contaminate 1 million gallons of fresh water – enough to supply 50 people with drinking water for one year. One pint of used motor oil improperly disposed of can create a one-acre slick on the surface of a body of water and kill floating aquatic organisms.
- Recycling used motor oil also saves valuable energy. Two gallons of used motor oil can generate 36-kilowatt hours of electricity. That's enough to run an average household for a day, cook 36 meals in a microwave, blow dry your hair 216 times, vacuum your house for 15 months or run your TV for 180 hours.
- Recycling used motor oil also helps to reduce dependency on foreign oil. Oil is the No. 1 source of energy for the U.S., supplying about 40 percent of the nation's overall energy needs according to the API. About half of the oil we consume is produced here in the U.S while the rest is imported.

## What happens to recycled motor oil?

Recycled motor oil can be used in a variety of ways. Most is processed for use in asphalt plants, industrial and utility boilers, steel mills and other facilities. Some is re-refined for use as a new generation of motor oil or as fuel oils. The rest is used in specially designed space heaters in automotive bays and municipal garages. The oil helps these types

### Recycling motor oil is the LAW in South Carolina.

That's right. In South Carolina, it's the law.

The S.C. Solid Waste Policy and Management Act of 1991 (Act) banned the disposal of motor oil in municipal solid waste (MSW) landfills after May 27, 1992.

The Act prohibits the disposal of oil into sewers, drainage systems, septic tanks, surface water or groundwater and on the ground.

The Act also prohibits the use of oil for road oiling, dust control, weed abatement and other uses that have the potential to harm the environment.

It must be recycled. If you have your oil changed for you (at a car dealership, garage or quick lube), your used motor oil is recycled by that business. If you change your own oil, you must recycle that used motor oil.

For more information about the recycling of used motor oil, filters or bottles in South Carolina including the nearest collection site, please call the Office at **1-800-768-7348** or visit **www.scdhec.gov/recycle**.

of facilities reduce their heating costs. This practice, however, is not recommended for home use.

Most of the oil collected from DIYers in South Carolina is burned for energy recovery to generate electricity by Santee Cooper, the state-owned utility. Santee Cooper estimates that it has collected more than 25 million gallons of used motor since 1990 (collected from DIYers and businesses) – enough to provide electricity to every average-sized home in South Carolina for six days.

## South Carolina has a slick program targeting DIYers.

API estimates that more than 50 percent of all motorists are DIYers. The U.S. Environmental Protection Agency (U.S. EPA) estimates that the largest single source of oil pollution harming our nation's waters is from DIYers. In fact, it is estimated that about 185 million gallons of used motor oil are improperly disposed each year – poured in storm drains or the sewer, dumped on the ground and tossed in the trash.

The good news – no, great news – in South Carolina is that the state has developed one of the nation's best and most comprehensive programs targeting DIYers. A used oil recycling program for DIYers began in South Carolina in 1990 when Santee Cooper collected nearly 3,000 gallons of used oil from eight locations. In 1991, Santee Cooper expanded the Give Oil for Energy Recovery (GOFER) program throughout the state. Following the passage of the Act, the S.C. Department of Heath and Environmental Control's (DHEC) Office of Solid Waste Reduction and Recycling (Office) began providing grant funding and technical assistance to local governments to set up used motor oil recycling centers. The combined efforts have resulted in one of the nation's top overall programs.

In calendar year 2010, DIYers in South Carolina recycled 984,437 gallons of used motor oil at nearly 900 collection sites throughout the state. Since 1990, more than 17 million gallons of used motor oil have been collected from DIYers.

Used motor oil filters and bottles also are collected from DIYers in most counties. Used motor oil filters are banned from MSW landfills unless "hot drained" or crushed to their smallest practical volume. The used motor oil filter recycling program began in 1994 with just three counties collecting filters. This is an important part of the overall recycling program because filters can contain from 4 ounces to 1 quart of oil. Most of the filters recycled in South Carolina are sent to several steel mills located in the state and made into new steel products.

South Carolina became one of the first states to collect used motor oil bottles, beginning a program in 1995 with two counties. Bottles are an important target for recycling for two reasons. First, oil bottles are made from a plastic that is recyclable in most local programs. Second, each bottle can contain as much as one ounce of oil that should be recovered before recycling. In addition the program offers recycling locations for farmers and for oil/gasoline mixtures.

For more information about the recycling of used motor oil, filters or bottles in South Carolina including the nearest collection site, please call the Office at **1-800-768-7348** or visit **www.scdhec.gov/recycle**.

### S.C. USED MOTOR OIL RECYCLING PROGRAM: A SUCCESS!

- **984,437 GALLONS** of used motor oil were collected for recycling in 2010.
- **MORE THAN 17 MILLION GALLONS** of used motor oil have been collected for recycling since 1990.
- **NEARLY 900 USED MOTOR OIL COLLECTION SITES** are throughout the state.
- **MOST COUNTIES COLLECT USED OIL FILTERS AND OIL BOTTLES** for recycling in addition to used motor oil.
- **95 OIL/GASOLINE MIXTURE COLLECTION TANKS** have been established in 42 counties.
- **66 FARMER OIL COLLECTION TANKS** have been established in 43 counties.

### USED OIL FACT

Local governments run the majority of the nearly 900 used motor oil collection sites in South Carolina. Retail stores – including Advance Auto Parts, Auto Zone, Tractor Supply Company and Walmart stores – also collect used motor oil from DIYers.

### DID YOU KNOW?

There were more than 209 million licensed drivers in the United States who drove on average more than 14,000 miles in 2009 (most recent data available) according to the U.S. Department of Transportation.

# GLOSSARY

## A

**aerate** – To expose to the circulation of air, as in aerating a compost pile.

**aeration** – A process that promotes biological degradation of organic matter in water. The process may be passive (as when waste is exposed to air) or active (as when a mixing or bubbling device introduces the air).

**aerobic** – Able to live and grow in the presence of free oxygen. Aerobic bacterial decomposition results in the conversion of organic wastes to compost.

**air** – A colorless, odorless, gaseous mixture, mainly nitrogen and oxygen.

**airborne** – Carried by or through the air.

**Air Quality Index** – A guide used to show the amount of air pollutants in the outside air as well as to provide information about possible health effects.

**albedo** – The fraction of incident electromagnetic radiation reflected by a surface, especially of a celestial body.

**algae** – Any of various chiefly aquatic, eukaryotic, photosynthetic organisms, ranging in size from single-celled forms to the giant kelp. Algae were once considered to be plants but are now classified separately because they lack true roots, stems, leaves and embryos.

**altitude** – The height of something measured in relation to a reference level, such as above the Earth's surface.

**aluminum** – A light, strong, silver-colored metal made mostly of bauxite ore. One of the most common materials accepted for recycling.

**aluminum can** – A container to hold a soft drink and other beverages. Aluminum cans can go from the recycling bin to a store shelf in as little as 60 days – again and again.

**ambient air** – Air that surrounds us.

**America Recycles Day (ARD)** – A day held nationally every November 15 to celebrate the importance of recycling and buying recycled. Events are held throughout the country. People are asked to sign challenge cards electronically, pledge to recycle and buy recycled.

**anaerobic** – Able to live and grow only in the absence of free oxygen; anaerobic decomposition of organic wastes by bacteria results in the production and release of methane gas.

**avoided waste disposal costs** – The amount of money that is saved by not disposing of recyclables as trash. Waste haulers charge customers a disposal fee for each pound or ton disposed or the number of times a waste container is picked up. Thus, it is important to include the avoided disposal cost as part of the savings that result from recycling.

## B

**backyard composting** – The act of composting at the household level using bins or piles of organic matter (yard trimmings, food scraps).

**biodegradable** – Capable of being broken down by microorganisms into simple, stable compounds such as carbon dioxide and water.

**Btu** (British thermal unit) – The amount of heat needed to increase the temperature of 1 pound of water $1^0$ Fahrenheit at sea level.

**burn barrel** – A barrel, usually a 55-gallon drum, in which household garbage is burned. It is against the law to burn household garbage in South Carolina.

**buy recycled** – Purchasing products made from or that contain materials with recycled content.

## C

**cadmium** – A soft, bluish-white metallic element occurring primarily in zinc, copper, and lead ores, that is easily cut with a knife and is used in low-friction, fatigue-resistant alloys, solders, dental amalgams, nickel-cadmium storage batteries, nuclear reactor shields and in rustproof electroplating.

**carbon** – A nonmetallic element found in some inorganic and all organic materials. Occurs naturally as diamonds and graphite.

**carbon dioxide ($CO_2$)** – A common, colorless, odorless gas formed by respiration, combustion and decomposition, comprises 0.03 percent of air.

**carcinogen** – A substance that can cause cancer.

**caution** – In hazardous household products labeling, caution means be careful. The product should be used with care.

**cell** – An area in a landfill where solid waste is disposed of each day.

**chasing arrows** – The universal recycling symbol. The three arrows symbolize the steps that complete recycling – collection; processing and manufacturing; and buying recycled. Also known as closing the loop.

**chemicals** – Substances with a distinct molecular composition that are produced by or used in a chemical process.

**chlorofluorocarbons (CFCs)** – Any of various compounds comprised of carbon, hydrogen, chlorine and fluorine

that were once used as coolants for refrigeration and air conditioning as well as in some products like aerosol hair spray. CFCs are harmful to the ozone layer.

**Class 3 landfill** – Any landfill, publicly or privately owned, that receives household waste – also known as municipal solid waste. The landfill may also receive other types of solid waste, including commercial waste, non-hazardous sludge and industrial solid waste.

**climate change** – Refers to any significant change in measures of climate (e.g., temperature, precipitation, wind) lasting for an extended period (decades or longer).

**compost** – The product resulting from the decomposition of organic materials such as yard trimmings and food scraps. Compost can be used as a soil conditioner.

**composting** – The conversion of organic materials to humus by microorganisms. Composting is an effective solid waste management method for reducing the organic portion of garbage, including lawn clippings, leaves, food scraps and manure.

**compost pile** – A place, such as an outside pit or bin, set aside for composting food scraps and yard trimmings.

**consumer** – A person who buys goods or services.

**consuming/consumption** – Buying and using goods or services.

**corrosive** – In hazardous household products labeling, corrosive means that a product may eat through other items.

## D

**danger** – In hazardous household products labeling, danger means that exposure or unsafe use may cause injury, illness or death.

**debris** – Leftover waste, often from a storm or building construction or deconstruction.

**decompose** – To break down into component parts or basic elements; decomposition of organic waste materials by bacteria is a fundamental life process because it makes essential nutrients available for use by plants and animals.

**DHEC (The S.C. Department of Health and Environmental Control)** – DHEC was created in 1973 when the State Board of Health and the Pollution Control Authority merged. DHEC is responsible for protecting the state's environment and the health of South Carolinians.

**dioxin** – A group of compounds that are extremely toxic.

**disperse** – To drive off or scatter in different directions.

**disposal** – The act or process of getting rid of something.

**do-it-yourselfer (DIYer)** – A term for people who choose to change their own motor oil. These people are the focus of campaigns to get people to recycle their used motor oil.

**dump** – An open, unmanaged, illegal disposal site used instead of a permitted landfill.

## E

**Earth Day** – Held on April 22 each year to promote awareness of environmental issues, the first Earth Day was in 1970.

**embedded energy** – The total amount of energy an item uses during its lifetime.

**endanger** – To expose to harm or danger.

**environment** – All the conditions, circumstances and influences surrounding and affecting the development or existence of people or other living things.

**environmental impact** – A positive or negative effect on an environment.

**environmental shopping** – The practice of making purchasing decisions based on a commitment to preserving the environment. Environmental shopping includes buying recycled products, products with a minimum of packaging and products that are not harmful when manufactured locally and can be recycled.

**erode** – The wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice and other mechanical and chemical forces.

**estimate** – To make a judgment.

**e-waste** – Electronic waste such as televisions and computers.

**explosive** – In hazardous household products labeling, explosive means to product can explode if used, stored or disposed of improperly.

## F

**fall line** – A line connecting the waterfalls of nearly parallel rivers that marks a drop in land level.

**fertilizer** – A material such as compost or a chemical compound added to soil to increase its fertility.

**filter** – A porous substance through which a gas or liquid is passed in order to remove its contaminants.

**finite** – Having bounds, limited. Finite commonly refers to non-renewable energy sources, such as fossil fuels.

**flammable** – In hazardous household products labeling, flammable means the product is easily ignited and capable of burning rapidly.

**fog** – Condensed water vapor in cloud-like masses lying close to the ground and limiting visibility.

**fungus** – Any of numerous eukaryotic organisms of the kingdom Fungi, which lack chlorophyll and vascular tissue and range in form from a single cell to a body mass of branched filamentous hyphae that often produce specialized fruiting bodies. The kingdom includes yeasts, molds, smuts and mushrooms.

## G

**garbage** – Another word for solid waste, particularly household waste.

**generation** – The act or process of producing solid waste.

**glass** – The container or packaging for many products including beverages and food. Glass can be recycled again and again with no loss in quality or purity. Glass containers go from the recycling bin to a store shelf in as little as 30 days – again and again.

**glassphalt** – A highway paving material in which recovered ground glass replaces some of the gravel in asphalt.

**global warming** – An increase in the near surface temperature of the Earth. Global warming has occurred in the distant past as the result of natural influences, but the term is most often used to refer to the warming predicted to occur as a result of increased emissions of greenhouse gases.

**grasscycling** – Refers to a method of source reduction whereby grass clippings are left on the lawn rather than bagged and set out for collection.

**greenhouse effect** – The trapping of heat on the surface of the earth.

**greenhouse gas** – A gas that absorbs and retains heat from the sun. Greenhouse gases include methane, ammonia, sulfur, dioxide and certain chlorinated hydrocarbons. A buildup of these gases traps warmth in the Earth's atmosphere changing the global climate.

**ground-level ozone** – Also known as "bad" ozone, it is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors and chemical solvents are some of the major sources of NOx and VOC. Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema and asthma.

**groundwater** – Water beneath the Earth's surface, often between saturated soil and rock that supplies wells and springs

## H

**hazardous** – Dangerous.

**hazardous household products** – Products found around the home, usually in small amounts, that can harm people or the environment. Examples of hazardous household products include paint, pesticides, cleaning supplies and batteries. Hazardous household products are not regulated as hazardous materials by South Carolina law, but are considered part of the municipal solid waste stream. Because of the nature of hazardous household products, they should be stored properly and disposed of separately from solid waste.

**humus** – Organic material consisting of decayed vegetable matter that provides nutrients for plants and increases water retention. A natural, rich, soil conditioner that is the result of composting.

## I-K

**incineration** – The burning of waste.

**incinerator** – A furnace for burning garbage or other waste under controlled conditions. A waste-to-energy incinerator burns waste to produce useful energy. Incinerators are federally regulated.

**inversion** – In the atmosphere, a layer of warm air that lies over a cooler air mass. An inversion traps pollutants close to the Earth's surface.

## L

**landfill** – A large, outdoor site for the burial of solid waste.

**lapse rate** – The rate of decrease of atmospheric temperature with increase in altitude.

**leachate** – Water that collects contaminants as it trickles through garbage, pesticides or fertilizer. Leachate can occur in farming areas, feed lots and landfills, and may result in hazardous substances entering surface water, groundwater or soil.

**lead** – A heavy metal that is hazardous to human health if breathed or swallowed. Its use in gasoline, paints, and plumbing compounds has been sharply restricted or eliminated by federal laws and regulations.

**lichen** – A fungus that grows symbiotically with algae, resulting in a composite organism that characteristically forms a crust-like or branching growth on rocks or tree trunks.

**litter** – Waste thrown away in an inappropriate place; improperly stored waste that has escaped from its container; misplaced solid waste. Littering is against the law in South Carolina.

**littering** – The act of intentionally or carelessly discarding solid waste in an inappropriate place.

## M

**man-made** – Made by human beings rather than occurring in nature.

**materials recovery facility (MRF, pronounced 'murf')** – A facility that sorts and processes collected recyclables for end users.

**methane** – The major component of natural gas.

**methane gas** – A colorless, odorless, flammable and explosive gas produced by decomposing garbage and other organic materials.

**MRF** – See materials recovery facility.

**mulch** – A layer of material such as wood chips or straw placed around plants to hold moisture, prevent weeds and enrich the soil.

**municipal solid waste (MSW)** – The combined residential and commercial solid waste generated in an area. MSW includes paper, cans, bottles, food scraps, yard waste and other items. Industrial process waste, agricultural waste, mining waste and sewage sludge are not MSW.

## N

**natural** – Present in or produced by nature.

**natural resources** – Valuable, naturally-occurring items such as plants, animals, minerals, water and air that are used by people to help make things such as energy, food, clothing and buildings.

**newspaper** – A publication, usually issued daily or weekly, containing current news, editorials, feature articles, and usually advertising. Newspapers are printed on newsprint – an inexpensive paper made from wood pulp.

**nitrogen** – A colorless, tasteless, odorless element that, as a gas, is relatively inert. Nitrogen makes up 78 percent of the atmosphere by volume and occurs as a constituent of all living tissues.

**nonpoint source pollution** – Contamination or water pollution that comes from many diffuse sources rather than a specific point such as a factory discharge pipe. Also known as runoff pollution.

**nonrenewable resources** – Natural resources which, because of their scarcity, the length of time required to form them, or their rapid depletion, are considered finite in amount, such as petroleum, coal, natural gas and copper.

## O

**Office of Solid Waste Reduction and Recycling** – An office established by the S. C. Solid Waste Policy and Management Act of 1991. The office is non-regulatory and non-enforcement. It is responsible for public awareness and education, technical assistance and grant funding to local governments, public and private schools, colleges and universities regarding solid waste management issues.

**oil** – Any of the various kinds of greasy, combustible substances obtained from animal, vegetable and mineral sources. Oils are liquid at ordinary temperatures and can be dissolved in certain organic solvents, but not in water. Petroleum is the most common form of oil.

**open burning** – The uncontrolled burning of household and other types of waste, e.g., burning household garbage in a barrel or burning leaves. It is against the law to burn household garbage in South Carolina.

**open dump** – A large open area where trash is illegally thrown. These areas are also called illegal dumps.

**organic** – An object containing the element carbon, such as plants and animals. Made from living organisms.

**organic material** – Discarded living material such as yard trimmings and food scraps.

**oxygen** – A non-metallic element constituting 21 percent of the atmosphere by volume that occurs as a diatomic gas, O2, and in many compounds such as water and iron ore. It combines with most elements, is essential for plant and animal respiration, and is required for nearly all combustion.

## P-Q

**packaging** – The wrapper, container or plastic film used to protect, identify and advertise a product.

**particulate matter** – Small solid particles, like dust or liquid droplets, that are suspended in the air.

**pesticide** – Any substance designed to kill living organisms, including insects (insecticides), plants (herbicides), fungi (fungicides), rats and mice (rodenticides), and bacteria (germicides).

**petroleum** – A natural, flammable, liquid hydrocarbon mixture found principally beneath the earth's surface and processed to make gasoline, natural gas, naphtha, fuel and lubricating oils. Also called crude oil.

**photosynthesis** – The process by which green plants synthesize carbohydrates from carbon dioxide and water using light as an energy source and releasing oxygen as a by-product.

**plankton** – The collection of small or microscopic organisms, including algae, that float or drift in great numbers in fresh or salt water and serve as food for larger organisms.

**plastic** – A material made from hydrocarbons known for its light weight and durability. Plastic can be rigid or pliable.

**plastic bottles** – Containers used to hold soft drinks, water, milk and other beverages as well as other products such as laundry detergent and shampoo.

**point source water pollution** – A type of water pollution that results from discharges in receiving water from easily identified points.

**poison** – A substance that can cause injury, illness or death.

**pollutant** – A liquid, gas, dust or solid material that causes contamination of air, water, earth and living organisms.

**pollute** – To make unfit for or harmful to living things, especially by the addition of waste.

**polluted runoff** – The part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water carrying pollutants from the air and land into receiving waters.

**pollution** – Harmful substances deposited in the air, water, or on land, leading to contamination of the environment.

**pollution prevention** – Identifying areas, processes and activities that create excessive waste products or pollutants in order to reduce or prevent them through alteration or eliminating a process.

**population** – All of the people inhabiting a specified area; the total number of such people.

**population growth rate** – A measurement on how quickly or slowly the population is increasing in a specific area.

**post-consumer materials** – Recovered materials collected from consumer oriented recycling collection system or drop-off center.

**pre-consumer materials** – Recovered materials obtained from manufacturers, such as cutting scraps from printers. Waste generated before the product reaches the consumer.

**precycle** – To reduce waste at the source by changing buying habits.

## R

**raw material** – An unprocessed natural resource used in manufacturing.

**reactive** – In hazardous household products labeling, reactive means a product is unstable and may undergo violent chemical change.

**recyclables** – Products or materials that can be collected, separated and processed to be used as raw materials in the manufacture of new products.

**recycle** – To collect, separate, process and market materials so they can be used again.

**recycled content** – The percent of a product's weight or package's weight that is composed of materials that have been recovered from waste. Recycled content may include pre-consumer and post-consumer materials.

**recycling center** – Drop-off sites that accept recyclables. Some sites also accept household garbage providing a one-stop service.

**recycling loop** – The cycle of collecting and processing, manufacturing products with recycled content and purchasing products containing recycled materials. Consumers "close the recycling loop" when they buy recycled-content items.

**reduce** – To lessen in amount. Reducing trash is a major solid waste management goal.

**reject** – To refuse to accept, submit to, believe or make use of.

**renewable** – Energy resources that can be replenished, such as sunlight, water, geothermal heat and biomass.

**renewable resource** – A natural resource derived from an endless or cyclical source (e.g., sun, wind, trees, fish); with proper management and wise use, replacement of these resources by natural or human-assisted systems can be approximately equal to their consumption.

**resource** – A supply of something that can be used or drawn upon. Something that can be used to make something else such as wood into paper, bauxite ore into aluminum, old bottles into new ones and sand into glass.

**resource recovery** – A practice that conserves natural resources by extracting used materials such as paper, glass and metals as well as energy from the waste stream and reprocessing them for reuse.

**reuse** – The use of a product more than once for any purpose. Examples include using a butter tub as an alternate food container or reusing a coffee can to hold nuts and bolts.

**runoff** – The portion of rainfall, melted snow or irrigation water that flows across land and eventually runs into streams. Runoff may pick up pollutants from the air or land and carry them to receiving waters.

## S

**sediment** – Soil, sand and minerals washed from land into water, usually after rain. Sediment piles up in reservoirs, rivers and harbors destroying fish, nesting areas and holes in which animals live. It also clouds the water so that needed sunlight may not reach aquatic plants.

**signal words** – Specific words used on hazardous household products to warn consumers on the proper use, storage and disposal of the product, e.g., CAUTION, EXPLOSIVE, FLAMMABLE, REACTIVE, POISONOUS and TOXIC.

**smog** – A mixture of air pollution, principally ground-level ozone, produced by chemical reactions in the air of smog-forming chemicals. Smog can harm health, damage the environment and cause poor visibility.

**smoke** – The vaporous system made up of small particles of carbonaceous matter in the air, resulting from the burning of organic material.

**soil** – The top layer of the Earth's surface.

**solid waste** – Garbage or trash. In the S.C. Solid Waste Policy and Management Act of 1991, solid waste is defined as any garbage, refuse, or sludge from a waste treatment facility, water supply plant or air pollution control facility; and other discarded material. It also includes solid, liquid, semi-solid or contained gaseous material resulting from industrial, commercial, mining and agricultural operations and community activities.

**solid waste management** – The supervised handling, processing and disposal of all solid waste.

**source reduction** – The practice of designing, manufacturing, buying and using materials (e.g., products and packaging) in ways that reduce the amount of waste generated.

**source water** – Untreated water from a river, stream or lake that is used to produce clean drinking water.

**S.C. Solid Waste Policy and Management Act of 1991** – The first comprehensive law dealing with solid waste management in South Carolina. The law established a policy of promoting solid waste reduction, recycling and reuse of materials before landfilling or incineration. It set a goal of reducing the amount of solid waste being received at municipal solid waste landfills and incinerators by 30 percent, calculated by weight, by May 1997. It also set a goal of recycling 25 percent, calculated by weight, of the total waste stream by May 1997.

**stagnant** – Not moving or flowing, motionless.

**storm drains** – Gutters and underground pipes that carry storm and runoff water away from streets into nearby streams, rivers and lakes.

**surface water** – Surface waters include streams, rivers, ponds, lakes and reservoirs. All fresh water that is not absorbed into the earth (becoming groundwater) or returned to the atmosphere as part of the water cycle is considered surface water. Only about 0.02 percent of all water on Earth is surface (fresh) water.

**sustainability** – The ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. An environmental protection strategy designed to protect the Earth's resources.

**sustainable development** – An environmental strategy designed to protect natural resources.

## T

**temperature inversion** – An atmospheric condition in which the air temperature rises with increasing altitude, holding surface air down and preventing dispersion of pollutants.

**tipping fees** – The price paid to dispose of waste in a landfill.

**tires** – As used in recycling, passenger car and truck tires (excludes airplane,

bus, motorcycle and special service military, agricultural, off-the-road and-slow speed industrial tires). Car and truck tires are recycled into rubber products such as trash cans, storage containers, rubberized asphalt or used whole for playground and reef construction.

**topography** – Detailed description or representation of the physical features of a region.

**toxic** – Capable of causing injury or death, by chemical means, poisonous.

**transfer station** – A facility where waste is removed from small collection vehicles and loaded onto larger transport vehicles or rail cars.

**trash** – Material considered worthless, unnecessary or offensive that is usually thrown away.

## U

**EPA** – The acronym for the U.S. Environmental Protection Agency. It is the federal agency of the U.S. government that sets environmental protection and enforcement standards. The EPA was created in 1970 and serves the entire country through its regional offices. South Carolina is in Region IV. The agency's headquarters is in Washington, D.C.

**used motor oil** – Motor oil that has been used in an engine and is considered to be waste. This oil can be recycled.

## V

**vermicomposting** – The production of compost using worms to digest organic waste.

**virgin materials** – Any basic material for industrial processes that has not previously been used. Another term for raw materials. Examples include timber or metal ore.

**volatile organic compounds (VOCs)** – gases released by certain solids or liquids, some of which may have a negative short- and long-term impact on health.

## W-X

**warning** – In hazardous household products labeling, warning means a stronger risk than caution, use with added care.

**waste** – Anything which is discarded or not considered useful.

**waste audit** – A process that will provide data on how much and what kind of waste is generated, disposed of and recycled as well as identify opportunities to reduce waste and recycle.

**waste minimization** – The reduction of the amount of waste generated by pollution prevention methods or recycling of by-products that would otherwise be added to the waste stream.

**waste reduction** – An important waste management strategy that encourages people to generate less trash through practices such as reuse, recycling and buying products with less packaging.

**waste stream** – All waste generated in an area or a facility.

**waste-to-energy facility:** Facility where recovered municipal solid waste is converted into a usable form of energy, usually via combustion.

**wastewater:** The spent or used water from a home, community, farm or industry that contains dissolved or suspended matter.

**water pollution** – Generally, the presence of a substance in the environment that because of its chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and human health effects. Under the Clean Water Act, the term has been defined as the man-made or man-induced alteration of the physical, biological, chemical and radiological integrity of water.

**watershed** – A ridge of high land dividing two areas that are drained by different river systems.

**water table:** The level of groundwater.

**waterway** – A navigable body of water, such as a river, channel or canal.

**wedge** – An elongated zone of relatively high atmospheric pressure. Also called ridge.

**wetland** – Areas covered with water for periods long enough to support plants and animals that thrive in wet soils. The areas may include bogs, swamps, marshes and wet meadows, but it is a misconception that all wetlands have standing water throughout the year.

**wind** – Moving air.

**worm castings** – Worm manure.

## Y-Z

**yard trimmings** – Grass clippings, shrub prunings, leaves, tree branches and other discarded material from yards and gardens.